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1969-21

Haystack Pointing System:
Moon with Offsets

H. E. Frachtman

P. P. Crowther, Editor

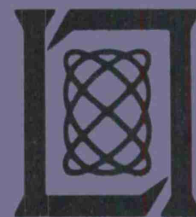
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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

HAYSTACK POINTING SYSTEM: MOON WITH OFFSETS

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Group 62

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TECHNICAL NOTE 1969-21

28 MARCH 1969

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LEXINGTON

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ABSTRACT

This report describes the procedure used by the Haystack pointing computer program for obtaining the celestial coordinates of any point on the Moon at any time.

Accepted for the Air Force
Franklin C. Hudson
Chief, Lincoln Laboratory Office

MOONTRACK

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I. INTRODUCTION

MOONTRACK is a program in the Haystack Univac 490 pointing system whose output is the celestial coordinates of a point on the Moon at a given time. The program computes the coordinates of the center of the Moon by 4th difference interpolation in the tables of the apparent right ascension, declination, and radius vector of the Moon published in The American Ephemeris. The rates of change of the three quantities are computed by numerical differentiation. If the "offset" option is selected, the topocentric celestial coordinates of a particular point on the moon are computed using linear interpolation in tables derived from values of mean equator, orbit, longitude, and elongation given in the American Ephemeris (P. 51).

II. INPUTS TO PROGRAM

A. Inputs Furnished by Core Memory

The program uses the registers listed in Table I for input information. The year and day are used to select the appropriate entries from the ephemeris. The coordinates of the Moon are interpolated for the time which is the sum of the times in CELTIME and DELTATEE.

B. Inputs Furnished by Magnetic Tape

The tape format of the Moon Ephemeris, which has been edited and recorded on tape by a CDC 3300 program described in Reference (1), is shown in Fig. 1. Each block of 192 words covers a period of one day. The ephemeris for each day requires 8 words for each of 24 hours. The program does not make use of the hour-year-month-day words in the block. The tape must be on Unit 1 (normally Servo B) of the Univac 490.

C. Typewriter Inputs

After the ephemeris values for the center of the moon have been read in, the program asks whether offsets are to be entered. If so, the observer has the option of typing in 1) selenographic latitude and longitude (in degrees), 2) selenographic direction cosines, 3) observer coordinates (direction cosines centered on the sub-radar point), or 4) delay (in milliseconds) and

angle (degrees). Figure 2 shows typical keyboard sequences.

III. PROGRAM OUTPUTS

A. Outputs Left in Core Memory

The apparent celestial coordinates of the selected point on the Moon corresponding to the time in the register CELTIME, together with their numerical derivatives, are stored in the appropriate registers, as illustrated in Table II. If the offset section is running, two registers are set to allow the DOPPLER program to compute offset doppler from leading edge doppler*: $D_{\text{off}} = D_{\text{l.e.}} \times \text{DOPFACTOR} + \text{MOONDOP2}$. The offset section also sets MOONSW to 1, which causes some modifications to the coordinate conversion program.

*Which comes from a special ephemeris tape - see Reference 4. Note that in "internal" doppler mode the offset doppler calculation is never done.

TABLE I
CORE MEMORY INPUTS TO MOONTRACK PROGRAM

<u>Register</u>	<u>Contents and Scaling</u>
W(CELTIME)	Days B28
W(DELTATEE)	Days B28
U(YEARMONTH)	Year B15 (4 decimal digits)
L(YEARMONTH)	Month B0
L(DAY)	Day of Year B0
W(EQUATOR)	Equatorial radius of Earth B17
W(SIDERTIME)	Right ascension of Haystack at CONVERTIME-2 ^S (radians B26)
W(GEOCENLAT)	Latitude of Haystack (degrees B20)

NOTE: Notation "B28" means that the binary point is to the right of bit 28.

3-62-3003

I. D.		13 _d	14		Conventional Day Number		0			
All Zero		19	Hour	14	Year	8	Month	4	Day	0
Right Ascension			B26			Radians				
First Difference	Right Ascension		B26			Radians				
Declination			B26			Radians				
First Difference	Declination		B26			Radians				
Radius Vector			B22			Earth Equatorial Radii				
First Difference	Radius Vector		B22			Earth Equatorial Radii				

Fig. 1. Magnetic tape format for moon ephemeris.

TABLE II

CORE MEMORY OUTPUTS OF MOONTRACK PROGRAM

<u>Register</u>	<u>Contents and Scaling</u>
W(RA)	Apparent Right Ascension B27 in revolutions
W(DEC)	Apparent Declination B27 in revolutions
W(RADIUS)	Distance from center of Earth to center of Moon, B22 Earth Equatorial radii
W(RADOT)	Numerical Derivative of Right Ascension B37 radians/sec.
W(DEC DOT)	Numerical Derivative of Declination B37 radians/sec.
W(RADIUS DOT)	Numerical Derivative of Radius Vector B24 nautical miles/sec
W(MOONSW\$)	0 for moon center run 1 for moon offset run
W(DOPFACTOR\$)	Dimensionless
W(MOONDOP2\$)	Cycles/sec B8. The last two values are used for offset doppler computations - see Ref. (4).

RIGHT ASC 1H 14M 12.40S
 DECLINATION 90 49 ' 22.58"
 DAY OF YEAR 51
 UNIVERSAL TIME 1 3H 45M 29.00S
 DISTANCE(E.R.) 60.808804
 OBJECT MOON
 OFFSET (Y/N) Y*
 LAT+LONG(1) DIR. COS(2) OBSERVER COORD(3) DELAY+ANG(4) 1*
 LAT= 4.294*
 LONG= 34.769*

 LAT+LONG(1) DIR. COS(2) OBSERVER COORD(3) DELAY+ANG(4) 2*
 X(S)= .568669*
 Y(S)= .074867*

 LAT+LONG(1) DIR. COS(2) OBSERVER COORD(3) DELAY+ANG(4) 3*
 X(O)= .5*
 Y(O)= .5*

 LAT+LONG(1) DIR. COS(2) OBSERVER COORD(3) DELAY+ANG(4) 4*
 DELAY(MS)= 7.0*
 ANGLE= 180*

Fig. 2. MOONTRACK initialization sequences.

B. Typewriter Outputs

During initialization the MOONTRACK program will type, using the INTERCOM subroutine, certain information concerning the Moon (see Figure 3). Items printed are:

1. Julian Day corresponding to values in YEARMONTH, DAY, and CELTIME (7 digits).
2. Apparent Right Ascension of the Moon (Hours, Minutes, Seconds to hundredths).
3. Apparent Declination of the Moon (Degrees, Minutes, Seconds to hundredths).
4. Day of Year corresponding to values in YEARMONTH and DAY (up to 3 digits).
5. Universal Time for which the coordinates are interpolated. It is the time in CELTIME at initialization (Hours, Minutes, Seconds to hundredths).
6. The distance between the centers of the Earth and the Moon (Earth's Equatorial radii to millionths).
7. The words "OBJECT MOON".

At this point the observer may select offsets, if desired; see part II-C.

If, after a search through 12 files on Unit 1 (or the finding of an end of tape mark), the moon ephemerides are not found, the program will type "MOON EPHEMERIS FOR X/Y NOT AMONG FIRST 12 FILES" and will exit to the master control program error return. "X" and "Y" indicate the current month and year, respectively.

If there is a tape servo malfunction during search, the program will type "IIIC STATUS S1 ZZ" and will exit to the master control program error return. The two digit octal number "ZZ" comes from the tape status word and indicates the error condition.

IV. ASTRONOMICAL SIGNIFICANCE

The apparent right ascension and declination of the Moon in the ephemerides are referred to the true equinox and equator of date and are corrected

for planetary aberration. They are geocentric apparent quantities; the parallax correction is made by the coordinate conversion program (COCON) in the Haystack system unless the moon offset program is running. (If MOONSW\$ is 1, COCON allows MOONTRACK to do the parallax correction and sets the center of the earth at the radar site for subsequent calculations.)

The values in the tables are computed for Ephemeris Time as argument. The equation

$$ET = UT + \Delta T$$

is used to convert from Universal Time to Ephemeris Time. The constant ΔT , represented by the number in the register DELTATEE, is approximately 39 seconds.

The values for the radius vector and first difference of the radius vector which appear on the ephemeris tape (Figure 1) are computed from the Moon's horizontal parallax which occurs in the source data. The formula

$$D = \frac{1}{\sin h}$$

is used by the tape preparation program (Reference 1) to compute the distance D, in units of Earth's equatorial radii, from the geocentric equatorial horizontal parallax h. The register EQUATOR contains a number which represents the Earth's equatorial radius in nautical miles.

V. PROGRAM DETAILS

The MOONTRACK program is a subroutine of the Haystack Univac 490 pointing program. The initialization section begins at MOONINIT, the working section at MOONCONT. There are several closed subroutines within the moon center part of MOONTRACK. These are: DAYFIND, STATUSCK, INTERPOL, LEFRNDOFF, and MOONTIME. An additional 29 closed subroutines perform the calculations required for pointing at an offset position on the moon. A listing of the program is given in Appendix IV.

A. Initialization

The program, upon initialization, stores a Release Interrupt Lockout

instruction in the tape channel internal interrupt register, and a call to the STATUSCK subroutine in the external interrupt register. The area in core into which the tape data will be read is cleared, together with some additional registers. This is done to make diagnosis easier in case of malfunction.

The daily Moon ephemeris entries are serially numbered by the program which generates the magnetic tape (Reference 1). These serial numbers are called "Conventional Day Numbers" (CDN). An arbitrary decision was made to produce and use tapes such that the CDN for April 1963 is zero. The tape search process looks at the first word in each block; therefore the MOONTRACK program must compute the CDN of the block containing the entry for the required hour.

Using as inputs the year, day of year, and CELTIME, the program computes the Julian Day number for the typewriter. The ephemerides start and run continuously from 25 April 1963, which has a Julian Day Number of 2438144.5; this number is subtracted from the computed Julian Day number and appears on tape as the Conventional Day Number. The first CDN in a block is stored in SAFE and TAPEBLOCK and the Moon identification number is added to generate a tape search comparison word.

Six blocks of Moon ephemerides are read to provide sufficient data for 4th difference Bessel interpolation for a four day period.

If the six block search and read operations are successful control is regained at NORMAL and the tape is rewound without interrupt or interlock.

The MOONTIME subroutine is entered to select and store the address of the ephemeris entries corresponding to the hour of the day and to compute the interpolation argument P. The register TIME2 contains a number representing the integral number of hours in the sum of CELTIME and DELTATEE.

Besselian interpolation of right ascension is done by the INTERPOL subroutine and the interpolated result is converted to hours, minutes, and seconds and stored for type out. Declination and distance are then interpolated and stored for type out. The other quantities which are to be typed out by INTERCOM are set up. Control is transferred to INTERCOM 7 times for the seven line type out.

Subroutine 1 of the moon offset section is then called. This asks, via INTERCOM, whether the operator wants to type in offsets, and calls one of four input subroutines (numbers 2 through 5) for the operator's choice of input format. The input routines leave either selenographic coordinates (X_s, Y_s, Z_s) or observer coordinates (X_o, Y_o, Z_o) in core for the working section of the program.

This completes operation of the MOONTRACK initialization section.

B. Working Section

The MOONTRACK working section begins at MOONCONT. Control is transferred to the subroutine MOONTIME which selects the ephemeris entry corresponding to the current hour, stores the addresses of the table entries, and computes the interpolation argument P from the given value of CELTIME. The INTERPOL subroutine is then entered three times for the interpolation of right ascension, declination, radius and their time rates. All values are converted, scaled and stored properly in core memory.

If C/S MOONSW\$ is zero at this point, control is transferred to the master control program.

If C/S MOONSW\$ is set to 1, subroutines 6 through 29 of the moon offset section are executed sequentially. Numbers 6 through 24 calculate the selenographic coordinates l' and b' of the subradar point, the apparent position angle C' of the moon's axis of rotation, and the rates of change of these three quantities. 25 through 29 calculate offsets in right ascension and declination and add them to RA and DEC in common storage, and calculate the doppler offset parameters MOONDOP2\$ and DOPFACTOR\$.

The equations used were derived by Thomas Thompson from references 2 (pp. 60-62) and 5 (pp. 63, 76-77).

C. Subroutines - Moon Center Section

The initialization section of the MOONTRACK program makes use of the INTERPOL, DAYFIND, STATUSCK, LEFRNDOFF, and MOONTIME subroutines. The working section uses all except STATUSCK.

1. INTERPOL

The MOONTRACK interpolation subroutine uses Bessel's interpolation formula for (Reference 3) 4th difference interpolation of the Moon's ephemeris. The formula is

$$f_p = f_0 + P\delta f_{1/2} + \frac{P(P-1)}{4} [\delta^2 f_0 + \delta^2 f_1] \\ + \frac{P(P-1)(P-1/2)}{6} \delta^3 f_{1/2} + \frac{(P+1)P(P-1)(P-2)}{48} (\delta^4 f_0 + \delta^4 f_1)$$

The quantities in the formula are associated with computer registers as follows:

- a. The address of f_0 is in index register 4.
- b. The interpolation argument P is in register P .
- c. $\delta f_{1/2}$ is in register GAMMA.
- d. $P(P-1)$ is in register PSQMP.
- e. $\delta^2 f_0 + \delta^2 f_1$ is in register DMINB.
- f. $\frac{P(P-1)}{6}$ is in register PSQMP6.
- g. $\delta^3 f_{1/2}$ is in register DMIN2CPLB.
- h. $(\delta^4 f_0 + \delta^4 f_1)$ is in register EP2BM2DMA.
- i. f_p is in the A register at the finish.

The subroutine also performs numerical differentiation using the following formula (Reference 3):

$$hf'_p = \delta f_{1/2} + \frac{2P-1}{4} [\delta^2 f_0 + \delta^2 f_1] \\ + \frac{3P^2 - 3P + 1/2}{6} \delta^3 f_{1/2}$$

At the completion of the subroutine, hf'_p is stored in the register NUMDERIV.

When the subroutine is entered, Index Register 4 contains the address of f_0 and the register SETINTAD contains the address of $\delta f_{1/2}$ of the quantity to be interpolated. Index register 3 is used to acquire the other two first difference registers.

2. DAYFIND

The DAYFIND subroutine computes the Julian Day number and CDN corresponding to the current day.

3. STATUSCK

The STATUSCK subroutine is entered from the external interrupt register associated with the tape channel when the interrupt occurs. Examination of the status code generates four possible outcomes:

a. If the code indicates a normal completion, control is returned to the program at the interrupted point.

b. If the code indicates that an end of tape mark was sensed, the tape is rewound and a message indicating failure to find the ephemeris is printed by the typewriter. The message is described in Section III B. Control is passed to the error return of the master control program.

c. If the code indicates that an end of file mark was sensed, the register IMPERIAL is indexed and tested for the value 12. When less than 12 an end of tape condition is assumed and the action is as described in (b) above.

d. If the code indicates anything but end of file, end of tape, or normal completion, a tape error has occurred. The message described in Section III B, indicating the type of error, is printed by the typewriter and control is passed to the error return of the master control program.

4. LEFRNDOFF

The LEFRNDOFF subroutine left shifts the AQ register the number of places indicated by the contents of index register 5 and rounds the A register.

5. MOONTIME

The MOONTIME subroutine computes the integral value of the current ephemeris hour and stores the addresses of the quantities to be interpolated.

It computes the value of the interpolation argument P.

D. Subroutines - Moon Offset Section

The following equations were used in the offset option section of the MOONTRACK program. The original MOONTRACK was not altered but augmented to accept additional input parameters and result in additional output parameters.

The additional subprograms or sections are numbered 1 through 29. The first five of these are initialization and the remaining are executed sequentially in the working section.

Appendix I is a list of internally stored constants and conversion factors.

Parameters concerning the offset are entered via the console during initialization. Additional ephemeris parameters have not been added to the EPHEMERIS tape but instead are located at the end of the program in four tables. The format of these tables, the interpolation procedure, and the Fortran program for generating them are given in Appendix III.

All other additional parameters are taken from COMMON storage or from the original moontrack program.

The labels used by the moon offset subroutines are defined in Appendix II and their scalings are given.

INITIALIZATION

Subprograms 1, 2, 3, 4, and 5 are independent subroutines.

(1) MXINIT

Via the console the following input is accepted:

	OFFSET (Y or N)
if Y	IAT/LONG (1), DIR-COSINE (2),
	OBSERVER-COORD (3), DELAY-ANG (4)

(2) MXINPOSA

Called if LAT/LONG was selected. Accepts selenographic latitude (β) and longitude (λ) as input via the console.

$$\beta = \text{(degrees)} \quad -90^\circ \leq \beta \leq 90^\circ$$

$$\lambda = \text{(degrees)}, \quad -180^\circ \leq \lambda \leq 180^\circ$$

It then determines the values

$$X_s = \cos \beta \sin \lambda$$

$$Y_s = \sin \beta$$

$$Z_s = \cos \beta \cos \lambda$$

(3) MXINPOSB

Called if DIR-COSINE was selected. Accepts the selenographic direction cosines (ξ, η) as input

$$X_s = \text{(} -1 \leq X_s \leq 1 \text{)}$$

$$Y_s = \text{(} -1 \leq Y_s \leq 1 \text{)}$$

Then finds the value

$$Z_s = [1 - X_s^2 - Y_s^2]^{1/2}$$

(4) MXINPOSC

This is the observer coordinate option, and accepts

$$X_o = \text{(} -1.0 \leq X_o \leq 1.0 \text{)}$$

$$Y_o = \text{(} -1.0 \leq Y_o \leq 1.0 \text{)}$$

to find

$$Z_o = (1 - X_o^2 - Y_o^2)^{1/2}$$

(5) MXINPOSD

This accepts the position as given by a delay and angle from the axis of rotation.

$$\text{DELAY} = (\text{milliseconds}, 0 \leq \text{DELAY} \leq 12.0)$$

$$\text{ANG} = (\text{degrees}, -360^\circ \leq \text{ANG} \leq 360^\circ)$$

The following is then calculated.

$$Z_o = 1 - \text{DELAY}/11.595 + \alpha[1 - 1/2 (\text{DELAY}/11.595)]$$

$$\Gamma_o = (1 - Z_o^2)^{\frac{1}{2}}$$

$$X_o = \Gamma_o \cos (90^\circ - \text{ANG})$$

$$Y_o = \Gamma_o \sin (90^\circ - \text{ANG})$$

where

$$\alpha = 4.52139 \times 10^{-3}$$

(6) MXLHA

$$\text{LHA}_o = \text{LST} - \alpha_o$$

$$d(\text{LHA}_o)/dt = \omega_\epsilon - d\alpha_o/dt$$

where

$$\alpha_o = \text{right ascension}$$

$$\text{LST} = \text{local sidereal time}$$

$$\omega_\epsilon = 7.292116 \times 10^{-5} \text{ rad/sec.}$$

(7) MXRO

$$\cos z_o = \sin \phi \sin \delta_o + \cos \phi \cos \delta_o \cos \text{LHA}$$

where

ϕ = geocentric latitude of site

δ_o = declination of moon

$$RT = [1 - 2 (\rho/D_o) \cos z_o + (\rho/D_o)^2]^{\frac{1}{2}}$$

$$R_o = D_o RT$$

$$\text{DELAY} = 2 R_o/c$$

where

$$1/c = 1/\text{speed of light} = .02127558 \text{ sec/e.r.}$$

ρ = geocentric radius of site in E.R.

D_o = center of earth to center of moon distance
in E.R., from ephemeris.

(8) MXRODT

$$\begin{aligned} d(\cos z_o)/dt &= (\sin \phi \cos \delta_o - \cos \phi \sin \delta_o \cos \text{LHA}) d\delta_o/dt \\ &\quad - (\cos \phi \cos \delta_o \sin \text{LHA}) d(\text{LHA})/dt \end{aligned}$$

$$dR_o/dt = \frac{1}{RT} [(1 - (\rho/D_o) \cos z_o) \frac{dD_o}{dt} - \rho_1 \frac{d(\cos z_o)}{dt}]$$

where

$$\rho_1 = \rho \text{ in n.m} = 3.438755435 \times 10^3$$

(9) MXDOP

$$\text{DOPD} = 2f_c \frac{dR_o}{dt} \left[1 - \frac{dR_o}{dt} \cdot \frac{1}{c} \right]$$

$$f_c = f_t/c$$

(10) MXA

$$A = -\cos \delta_o \sin LHA$$

$$\frac{dA}{dt} = -\sin \delta_o \sin LHA \frac{d\delta_o}{dt} + \cos \delta_o \cos LHA \frac{d(LHA)}{dt}$$

(11) MXB

$$B = \cos \delta_o \cos LHA - (\rho/D_o) \cos \phi$$

$$\begin{aligned} \frac{dB}{dt} = & -\sin \delta_o \cos LHA \frac{d\delta_o}{dt} - \cos \delta_o \sin LHA \frac{d(LHA)}{dt} \\ & + (\rho/D_o^2) \cos \phi \frac{dD_o}{dt} \end{aligned}$$

(12) MXC

$$C = \sin \delta_o - (\rho/D_o) \sin \phi$$

$$\frac{dC}{dt} = \cos \delta_o \frac{d\delta_o}{dt} + (\rho/D_o^2) \sin \phi \frac{dD_o}{dt}$$

(13) MXDELP

$$\sin \delta' = \frac{CD_o}{R_o}$$

$$\delta' = \sin^{-1} (\sin \delta')$$

calculates $\cos \delta'$

(14) MXALF

$$AB = \frac{D_o \cos \delta'}{R_o}$$

$$\sin LHA' = A/AB$$

$$LHA' = \sin^{-1} (\sin LHA')$$

$$\alpha' = \begin{cases} LST - LHA' & \text{if difference is positive.} \\ LST - LHA' + 2\pi & \text{if difference is negative.} \end{cases}$$

(15) MXDECPDT

$$AB = [A^2 + B^2]^{\frac{1}{2}} = \frac{D_o \cos \delta'}{R_o}$$

$$\frac{d(AB)}{dt} = \frac{\frac{A}{AB} \frac{dA}{dt} + \frac{B}{AB} \frac{dB}{dt}}{AB}$$

$$\frac{d\delta'}{dt} = (AB \frac{dC}{dt} - C \frac{dAB}{dt}) / (R_o^2 / D_o^2)$$

(16) MXAPDT

$$\frac{d\alpha'}{dt} = \omega_e - \frac{[B \frac{dA}{dt} - A \frac{dB}{dt}]}{2 AB}$$

(17) MXA1

$$AA = -\cos \delta' \cos (\alpha' - \Omega')$$

$$\frac{dAA}{dt} = \sin \delta' \cos (\alpha' - \Omega') \frac{d\delta'}{dt} + \cos \delta' \sin (\alpha' - \Omega') \frac{d\delta'}{dt}$$

(18) MXB1

$$BB = -\cos \delta' \cos i \sin (\alpha' - \Omega') - \sin \delta' \sin i$$

$$\begin{aligned} \frac{d(BB)}{dt} &= [\sin \delta' \cos i \sin (\alpha' - \Omega') - \cos \delta' \sin i] \frac{d\delta'}{dt} \\ &\quad - \cos \delta' \cos i \cos (\alpha' - \Omega') \frac{d\alpha'}{dt} \end{aligned}$$

(19) MXC1

$$CC = \cos \delta' \sin i \sin (\alpha' - \Omega') - \sin \delta' \cos i$$

$$\begin{aligned} \frac{d(CC)}{dt} &= [-\sin \delta' \sin i \sin (\alpha' - \Omega') - \cos \delta' \cos i] \frac{d\delta'}{dt} \\ &\quad + \cos \delta' \sin i \cos (\alpha' - \Omega') \frac{d\alpha'}{dt} \end{aligned}$$

(20) MXSINBP

$$\sin b' = CC$$

$$b' = \sin^{-1} (\sin b')$$

calculates $\cos b'$

(21) MXSINLP

$$l' = \sin^{-1} \left[\frac{BB}{\cos b'} \right] - (\mathcal{C} - \Omega + \Delta)$$

calculates $\sin l'$, $\cos l'$

(22) MXSINCP

$$\sin C' = -\sin i \cos (\alpha' - \Omega') / \cos b'$$

$$C' = \sin^{-1} (\sin C')$$

calculates $\cos C'$

(23) MXBPDT

$$\frac{db'}{dt} = \left(\frac{d(CC)}{dt} \right) / \cos b'$$

(24) MXLPDT

$$\frac{dl'}{dt} = \left[A \frac{d(BB)}{dt} - B \frac{d(AA)}{dt} \right] / \cos^2 b' - \frac{d}{dt} (\mathcal{C} - \Omega + \Delta)$$

(25) MXFCL

$$\omega_x = db'/dt$$

$$\omega_y = -\cos b' dl'/dt$$

$$\omega_a = [\omega_x^2 + \omega_y^2]^{\frac{1}{2}}$$

$$FCL = -2 f_c b \omega_a \left[1 - \frac{1}{c} d R_o / dt \right],$$

where b = lunar radius in n.m.

(26) MXDA

$$\sin da = \omega_x / \omega_a$$

$$\cos da = \omega_y / \omega_a$$

(27)* MXXYZ (If input was selenographic coords)

$$X_o = X_s \cos l' - Z_s \sin l'$$

$$Y_o = -X_s \sin l' \sin b' + Y_s \cos b' - Z_s \cos l' \sin b'$$

$$Z_o = X_s \sin l' \cos b' + Y_s \sin b' + Z_s \cos l' \cos b'$$

(28) MXDELALF

$$S = b/R_o, \quad b = \text{lunar radius}$$

$$\Delta\alpha = - [X_o \cos C' - Y_o \sin C'] S / \cos (\delta')$$

$$\Delta\delta = [Y_o \cos C' + X_o \sin C'] S$$

(29) MXDPDOP

$$RTX = [1 - 2 Z_o S + S^2]^{\frac{1}{2}}$$

$$D_p = \text{DELAY} \cdot RTX$$

$$\text{DOP1} = [1 - Z_o S] \text{DOPP}/RTX$$

$$\text{DOP2} = -X_d \text{FCL}/RTX = C/S \text{ MOONDOP2}\$, \text{ Hz B8.}$$

$$\text{DOPPLER} = \text{DOP1} + \text{DOP2}$$

$$X_d = X_o \cos da - Y_o \sin da$$

$$\alpha_p = \alpha' + \Delta\alpha$$

$$\delta_p = \delta' + \Delta\delta$$

*Equ. (52), p. 77 of Reference 5.

(29) MXDPDOP (Continued)

$$R_p = R_o \cdot RTX$$

$$dR_p/dt = [(1 - Z_o S) dR_o/dt + \omega_b X_d]/RTX$$

$$C/S \text{ DOPFACTOR\$} = DOP1/DOPP = [1 - Z_o S]/RTX$$

E. Utility Subroutines - Moon Offset Section

1. ROUND Rounds value in AQ to A
2. SINX (COSX) In: A = * radians
 Q = B (binary point)
 Out: A = sin (cos) * B28
3. SQRT In: A = N (binary point at 2M, where
 M is an integer)
 Out: A = \sqrt{N} (binary point at M + 14)
4. SOVERFLOW General error routine---prints the error
 address on the high speed printer, sets
 A to zero, and exits.
5. ASINX (ACOSX) In: A = sin (cos) *
 Q = B (binary point)
 Out: A = * B27 radians
6. SADD (SSUB) In: A = X
 Q = Y
 Output: A = X , Y

 This routine has an error return to the calling
 address + 1, normal return to calling address
 + 2.

CONSTANTS					
<u>Quan.</u>	<u>Label</u>	<u>Value</u>	<u>Unit</u>	<u>B</u>	<u>Description</u>
1/c	MKQCCER	.02127558	sec/e.r.	29	reciprocal of speed of light
1/c	MKQRCNM	6.1775959×10^{-6}	sec/n.m.	37	" " " " "
b	MKQBER	.2724876721	e.r.	29	lunar radius
b	MKQBNM	938.4449184	n.m.	19	" "
-	MKQ11	11.595	ms	25	center-to-limb time delay
-	MKHLF	0.500	-	29	- - - -
-	MKQNMPER	3.4439903×10^3	-	27	conversion factor n.m./e.r.
-	MKQERPNM	$2.903608566 \times 10^{-4}$	-	40	" " e.r./n.m.
-	MKRADDEG	.017453295	-	29	" " rad./deg.
-	MKONE28	1.000	-	28	- - - -
-	MKQR11	.08624407	1/ms	29	1/11.595
ζ	MKQRHO	.99848	e.r.	29	geocentric radius of site
α	MKQALF	4.52139×10^{-3}	-	29	
ζ	MKQRO	3.4387554×10^3	n.m.	17	geocentric radius of site
ω_e	MKQWE	7.292116×10^{-5}	rad/sec	42	ω_e angular velocity of earth
f_c	MKQFC	4.787638×10^4	cyc/n.m.	13	frequency of transmitter /c

CONSTANTS & CONVERSION FACTORS

<u>Label</u>	<u>Value</u>	<u>B</u>
REVS RADIAN	revolutions/radians	31
HALFDAY	1/2	28
HOURL	days/hour	28
SRAD	seconds/radian	15
HRAD	radians/hour	28
MINSRAD	radians/minute	36
HDAY	days/hour	32
MDAY	days/min	39
SDAY	seconds/day	12
SECSRAD	radians/second	42
SARAD	seconds/radian	
RHRSEC	hours/sec	40
TWOPIE	2 π	26
THIRD	1/3	28
SIXTH	1/6	28

APPENDIX II

LABELS, Definitions, & Scaling (moon offset section)

OUTPUT

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
1	MOONSW\$*	0 = no offset 1 = offset		0
	MKPOSSW*	0 = selenographic position B, λ 1 = selenographic position ξ, η 2 = observer coordinates 3 = delay & axis of rotation		0
2	MKINBETA	input β	deg.	20
	MKINLAMBDA	input λ	deg.	20
	MKBETA	input β	rad.	27
	MKLAMBDA	input λ	rad.	27
	MKSINB	sin β	-	28
	MKCOSE	cos β	-	28
	MKSINL	sin λ	-	28
	MKCOSE	cos λ	-	28
	MKXS*	X_s	-	28
	MKYS*	Y_s	-	28
	MKZS*	Z_s	-	28
3	MKXS2	X_s^2	-	28
	MKYS2	Y_s^2	-	28
	MKZS2	Z_s^2	-	28
	MKZS*	Z_s	-	28
4	MKXO2	X_o^2	-	28
	MKYO2	Y_o^2	-	28
	MKZO2	Z_o^2	-	28
	MKZO*	Z_o	-	28

*Indicate final output of routine

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
5	MKDANG	$\pi/2$ - input *	rad	27
	MKSINDA	$\sin (\pi/2 - *)$	-	28
	MKCOSDA	$\cos (\pi/2 - *)$	-	28
	MKDKK2	$D/11.595$	-	28
	MKT1	$\alpha[1 - 1/2 (D/11.595)]$	-	28
	MKT2	$1 - D/11.595$	-	28
	MKZO*	Z_o	--	28
	MKZO2	Z_o^2	-	28
	MKZRO2	$1 - Z_o$	-	28
	MKZRO	$(1-Z_o)^{\frac{1}{2}}$	-	28
	MKXO*	X_o	-	28
	MKYO*	Y_o	-	28
6	MKLHA*	lha (geocentric)	rad	26
	MKLHADT*	$d(lha)/dt$	rad/sec	42
7	MKGEOLAT	ϕ_c	rad	26
	MKSINGLAT	$\sin \phi_c$	-	28
	MKCOSGLAT	$\cos \phi_c$	-	28
	MKSINDEC	$\sin \delta_o$	-	28
	MKCOSDEC	$\cos \delta_o$	-	28
	MKCOSLHA	$\cos (lha)$	-	28
	MKSINPHID	$\sin \phi_c \sin \delta_o$	-	28
	MKCOSPHID	$\cos \phi_c \cos \delta_o$	-	28
	MKCOSZO	$\cos z_o$	-	28
	MK4	ξ/D_o	-	33
	MKRDHODCOS	$2 \xi/D_o \cos z_o$	-	29
	MK42	(ξ/D_o)	-	28
	MKRT2	$(Ro/D_o)^2$	-	28
	MKR0*	Ro	e.r.	23
	MKDELAY*	delay	sec.	27
	MKRT	(Ro/D_o)	-	28
8	MKCOSDPHI	$\sin \phi \cos \delta_o$	-	28
	MKSINDPHI	$\cos \phi \cos (lha) \sin \delta_o$	-	28
	MKT1		rad/sec	42
	MK2	$\sin (lha) \cos \delta_o$	-	42
	MKDDTCOS*	$d(\cos z)/dt$	rad/sec	42

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
8 (cont'd)	MKT3	$(1 - MK4 \cos z_o) dR_o/dt$	n.m./sec	
	MKT4	$2\rho_o d(\cos z_o)/dt$	-	29
	MKT5	$1/MKRT$	-	28
	MKT7		-	
	MKRODT*	$MKT5(MKT3 + MKT4)$	n.m./sec	29
9	MKT1	$2 f_c dR_o/dt$	cyc/sec	12
	MK20	$1/c dR_o/dt$	"	37
	MKT3	$MK20 \cdot MKT1$	"	12
	MKDOPP*	Doppler: $MKT3 - MKT1$	"	12
10	MK1	$\cos \delta \cos (lha)$	-	28
	MKT2	$\sin \delta \sin (lha)$	-	28
	MKT4	$MKT2 d\delta/dt$	rad/sec	42
	MKT3	$MK1 d(lha)/dt$	"	42
	MKCA*	A	rad	28
	MKCADT*	dA/dt	rad/sec	42
11	MK3	$\sin \delta \cos (lha)$	-	28
	MK5	$MK4 \cos \phi$	-	33
	MKCB*	B	-	28
	MKT1	$MK3 d\delta/dt$	rad/sec	42
	MKT2	$MK2 d(lha)/dt$	"	42
	MKT3	$MK5/D_o d D_o/dt$	"	42
	MKCBDT*	dB/dt	"	42
12	MK6	$K4 \sin \phi_c$		33
	MKCC*	C		28
	MKT1	$\cos \delta_o d\delta_o/dt$	rad/sec	42
	MKT2	$K6/D_o dD_o/dt$	"	42
	MKCCDT*	dC/dt	"	42

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
13	MKSINDP	$\sin \delta'$	-	28
	MKDP*	δ'	rad	26
	MKCOSDP	$\cos \delta'$	-	28
14	MKAB	AB	-	28
	MKAB2	$(AB)^2$	-	28
	MKSINLHAP	$\sin (lha')$	-	28
	MKLHAP*	lha'	rad	26
	MKALFP*	α'	rad	26
15	MKT1	AdA/dt	rad/sec	42
	MKT2	BdB/dt	"	"
	MKT3	T1 & T2	"	"
	MKABDT	$d(AB)/dt$	"	"
	MKT4	$AB \ d \ C/dt$	"	"
	MKT5	$C \ d(AB)/dt$	"	"
	MKT6	T4-T5	"	"
	MKDPDT*	$d\delta'/dt$	"	"
16	MKT1	BdA/dt	rad/sec	42
	MKT2	AdB/dt	"	"
	MKT3	T1-T2	"	"
	MKT4	$T3/AB^2$	"	"
	MKAPDT*	$d\alpha'/dt$	"	"
17	MK7	$K7 = \alpha' - \Omega'$	rad	26
	MK8	$K8 = \cos (\alpha' - \Omega')$	-	28
	MK9	$K9 = \sin (\alpha' - \Omega')$	-	"
	MK10	$K10 = \cos \delta' \cos (\alpha' - \Omega')$	-	"
	MK11	$K11 = \cos \delta' \cos (\alpha' - \Omega')$	-	"
	MK12	$K12 = \sin \delta' \cos (\alpha' - \Omega')$	-	"
	MK13	$K13 = \sin \delta' \sin (\alpha' - \Omega')$	-	"
	MKT1	$K11 \ d\alpha'/dt$	rad/sec	42

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
17 (con'd)	MKT2	$K12 \, d\delta'/dt$	rad/sec	42
	MKCA1*	-K10	-	28
	MKCALDT*	$K12 \, d\delta'/dt + K11 \, d\alpha'/dt$	rad/sec	42
18	MKT1	$K11 \cos i$	-	28
	MKT2	$\sin \delta' \sin i$	"	"
	MKCB1*	B'	"	"
	MKT3	$\cos \delta' \sin i$	"	"
	MKT4	$K13 \cos i$	"	"
	MKT7	$T4 - T3$	"	"
	MKT5	$T7 \, d\delta'/dt$	rad/sec	42
	MKT8	$K10 \cos i$	-	28
	MKT6	$T8 \, d\alpha'/dt$	rad/sec	42
	MKCB1DT	dB'/dt	"	"
19	MK14	$K11 \sin i$	-	28
	MK15	$\sin \delta' \cos i$	-	"
	MK16	$\cos \delta' \cos i$	-	"
	MK17	$K10 \sin i$	-	"
	MK18	$K13 \sin i$	-	"
	MKCC1*	$K14 - K15$	-	"
	MKT1	$K17 \, d\alpha'/dt$	rad/sec	42
	MKT3	$K16 + K18$	-	28
	MKT2	$T3 \, d\delta'/dt$	rad/sec	42
	MKCC1DT	dC'/dt	"	"
20	MKSINBP	$\sin b'$	-	28
	MKBP*	b'	rad	27
	MKCOBP	$\cos b'$	-	28

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
21	MKT1	$B'/\cos b'$	-	28
	MKT2	$\arcsin (B'/\cos b')$	rad	"
	MKLP*	ℓ'	"	26
	MKCOLP	$\cos \ell'$	-	28
	MKSINLP	$\sin \ell'$	-	28
22	MKSINCP	$\sin C'$	-	28
	MKCP*	C'	rad	27
	MKCOLCP	$\cos C'$	-	28
23	MKBPD*	db'/dt	rad/sec	42
24	MKT4	$B' dA'/dt$	rad/sec	42
	MKT5	$A' dB'/dt$	"	"
	MKT1	$T5 - T4$	"	"
	MKT3	$\cos^2 b'$	-	28
	MKT2	$T1/T3$	rad/sec	42
	MKT4	$T2-d/dt (\Delta-\Omega)$	"	"
	MKLPD*	dL'/dt	"	"
25	MKW*	ω_x	rad/sec	42
	MKW*	ω_y	"	"
	MKT1	ω_x^2	"	"
	MKT2	ω_y^2	"	"
	MKT3	$\omega_x^2 + \omega_y^2$	"	"
	MKWA*	ω_a	"	42
	MKT1	$1/c dRo/dt$		37
	MKT2	$2 f_c b \omega_a$		22
	MKT3	$T2 \cdot T1$		22
	MKFCL*	FCL	cyc/sec	22
26	MKCOLDA*	$\cos d_a$	-	28
	MKSINDA*	$\sin d_a$	-	28

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
27	MKT2	$Z_s \sin l'$	-	28
	MKT1	$X_s \cos l'$	-	"
	MKX0*	X_o	-	"
	MKT9	$Z_s \cos l'$	-	"
	MKT5	$T_9 \sin b'$	-	"
	MKT10	$X_s \sin l'$	-	"
	MKT4	$T_{10} \sin b'$	-	"
	MKT3	$Y_s \cos b'$	-	"
	MKY0*	Y_o	-	"
	MKT6	$T_{10} \cos b'$	-	"
	MKT7	$Y_s \sin b'$	-	"
	MKT8	$T_9 \cos b'$	-	"
	MKZ0*	Z_o	-	"
28	MKS*	S	-	35
	MKT1	$S/\cos \delta'$	-	28
	MKT2	$X_o \cos C'$	-	"
	MKT3	$Y_o \sin C'$	-	"
	MKT4	$T_2 + T_3$	-	"
	MKDELALF*	$\Delta\alpha$	rad	35
	MKT5	$X_o \sin C'$	-	
	MKT6	$Y_o \cos C'$	-	
	MKT7	$T_6 - T_5$	-	
	MKDELDEL*	$\Delta\delta$	rad	35
29	MKS2	S^2	-	34
	MKT1	$z_o S$		34
	MKT5	$S^2 - 2 z_o S$		28
	MKRTX2	RTX^2		28
	MKRTX	RTX		28
	MKDPX*	DP		27
	MKT2	1-T1		

<u>Routine</u>	<u>Label</u>	<u>Description</u>	<u>Unit</u>	<u>B</u>
29 (cont'd)				
	MKT3	DOPP/RTX		12
	MKT4	FCL/RTX	cyc/sec	12
	RA*		rev	27
	RADOT*	ϕ	-	-
	DEC*		rev	27
	DECDOT*	ϕ	-	-
	RADIUS*		e.r.	22
	RADIUSDOT*		n.m./sec	24
	MKDOP1*	DOP1	cyc/sec	12
	MKDOP2*	DOP2	"	"
	MKDOPPLER*	DOPPLER	"	"
	MKXD*	X_d	"	"
	MOONDOP2\$	DOP2		8
	DOPFACTOR\$*	DOP1/DOP2	-	28

APPENDIX III MOON OFFSET EPHEMERIS TABLES: GENERATION AND USE

CALCULATION OF T FOR EPHEMERIS INTERPOLATION

$$D_1 = \text{day of year} = L(\text{DAY}), \quad \text{days B0}$$
$$D_0 = \text{1st day of table} = L(\text{EPHDAY}), \quad \text{days B0}$$

T₁ = time of day = W (CELTIME), days B28

EPH(T) = interpolated ephemeris table value for present time.

$$1. \quad (D_1 - D_0) / 10 = K + R/10$$

K = integer
R = remainder

$$2. \quad T = (R + T_1) / 10, \text{ days B27}$$
$$3. \text{ EPH}(T) = \text{EPH}_k + (\text{EPH}_{k+1} - \text{EPH}_k) T$$

EPHEMERIS TABLE

The table of ephemeris values must be in the following format:

W(EPHCNT) = no. values in each of the four tables.

W(EPHDAY) = the day of year for the first value in each table.

The following storage allocations must remain in the order:

MKQK1 (EPHCNT locations)

MKQRST (EPHCNT locations)

MKQI (EPHCNT locations)

MKQSP (EPHCNT locations)

The four tables containing the data at ten (10) day intervals and consisting of EPHCNT values must be in the order:

$W(EPHRST) = 1st \text{ value of } (\mathcal{C} - \Omega + \Delta), \text{ rad B26}$

$W(EPHRSTDt) = 1st \text{ value of } d \left(\frac{\mathcal{C} - \Omega + \Delta}{dt} \right), \text{ rad/sec B42}$

$W(EPHI) = 1st \text{ value of } i, \text{ rad B26}$

$W(EPHSP) = 1st \text{ value of } \Omega', \text{ rad B27.}$

These tables must be updated at the beginning of each year, using the CDC 3300 Fortran program MOONKEPH, with input data from the American Ephemeris and Nautical Almanac. (See next two pages)

APPENDIX IV LISTING OF MOONTRACK PROGRAM

PROGRAM NAME: MOONKEPH

MACHINE: CDC 3300

LANGUAGE: FORTRAN

AUTHORS: R. Shaputnic Cuomo and P. Crowther

PURPOSE: To generate a moon libration ephemeris deck for use in the MOONTRACK program of the Univac 490 Haystack Pointing System. This deck must be updated at the start of each year.

INPUT: Cards punched from Page 51 of the American Ephemeris and Nautical Almanac - numbers in free format (integer, floating point, or E-format), separated by spaces or commas.

<u>Card Number</u>	<u>Contents</u>
1	Year
2	Month number, day, i_1 , Δ_1 , Ω_1 , Γ_1 , Ω_1 , C_1 , D_1
$n + 1$	Month _n , day _n , i_n , Δ_n , Ω_n , Γ_n , Ω_n , n , n
$n + 2$	BLANK

Data cards are spaced at 10-day intervals and must include at least 3 intervals before the beginning of the year (marked as month #1, with negative day numbers) and 2 intervals after the end of the year.

OUTPUT: Cards in U490 SPURT format for insertion into the MOONTRACK deck.

Column	1	12	22
EPHCNT	EQUALS COMMENT	NN (number of entires in each table) FOLLOWING VALUES FOR YEAR NNNN	
EPHRST	DEC	X.XXXXXXXXXXB26	NN values
	DEC	X.XXXXXXXXXXB26	
EPHRSDTDT	:		NN values
	DEC	X.XXXXXXXXXXB26	
EPHC	DEC	.XXXXXXXXXXB28	NN
	DEC	.XXXXXXXXXXB26	
EPHSP	DEC	.XXXXXXXXXX B26	NN
	DEC	XX.XXXXXXXXXXB26	
	DEC	XX.XXXXXXXXXXB26	

where

$$EPHRST_j = j - \Omega_j + \Delta_j \text{ in radians, } 0 \leq EPHRST < 2$$

$$EPHRSDTDT_j = \frac{2^{14} \cdot 2\pi}{86400 \cdot 360} \left[\frac{\Delta_{j-2} - 8\Delta_{j-1} + 8\Delta_{j+1} - \Delta_{j+2}}{120} + 13.176393 + .05296 \right]$$

$$EPHI_j = \frac{2\pi}{360} \times i_j$$

$$EPHSP_j = \frac{2\pi}{360} \times \Omega'_j$$

```

PROGRAM MOONKEPH
C SHAPUTNIC, 27 DEC 66
C MODIFIED BY P. CROWTHER--21 JANUARY 1969
  DIMENSION INAME(2),PTHING(12),IPTHING(3)
  CHARACTER PTHING
  EQUIVALENCE (PTHING,IPTHING)
  DIMENSION ZI(75),DEL(75),DOM(75),GAM(75),OM(75),DML(75),EC(75),
1THING(75),DTHING(75),DZI(75),DDOM(75)
  DIMENSION XTHING(75),A(20)
  QD=1.74532925E-2
  I=1
  CALL A CARD IN(A,NC)
  IYEAR = A(1)
3  A(1) = 0 $ CALL A CARD IN (A,NC)
  MO = A(1)+.5 $ IDAY = A(2)+SIGNF(0.5,A(2))
  ZI(I) = A(3) $ DEL(I) = A(4)
  DOM(I) = A(5) $ GAM(I)=A(6) $ OM(I) = A(7) $ DML(I) = A(8)
  EC(I) = A(9)
  IF(I .EQ. 1) 17,18
17 IDAYX = IDAY
18 IF(MO) 1,2,1
  1 I=I+1
  GO TO 3
  2 II=I-1
  DO 4 J=1,II
    TH =DML(J)-OM(J)+DEL(J)+720.
    ITH=TH/360.
  4 THING(J)=(TH-(ITH*360))*QD
    K=I-3
    CON1=13.176396*QD
    CON2=-.05296*QD
    DO 5 J=3,K
      XTHING(J)=((DEL(J-2)-8.*DEL(J-1)+8.*DEL(J+1)-DEL(J+2))/12.0)/10.0
  5 DTHING(J)=(QD*XTHING(J)+CON1-CON2)/86400.
    DO 6 J=3,K
      DZI(J)=QD*ZI(J)
  6 DDOM(J) = QD*DOM(J)
    DO 7 J=3,K
      DTHING(J) = 2.*+14*DTHING(J)
    KK = K-2 $ WRITE (61,201) KK $ WRITE (62,202)KK
201 FORMAT (22H EPHCNT EQUALS ,I2,1HD)
202 FORMAT (21HEPHCNT EQUALS ,I2,1HD)
    IDAY3=IDAYX+20 $ WRITE(61,301)IDAY3 $ WRITE(62,302) IDAY3
301 FORMAT(12H EPHDAY ,I2)
302 FORMAT (11HEPHDAY ,I2)
    WRITE(61,401)IYEAR $ WRITE(62,402)IYEAR
401 FORMAT(12X,10HCOMMENT ,26HFOLLOWING VALUES FOR YEAR ,I4)
402 FORMAT (11X,10HCOMMENT ,26HFOLLOWING VALUES FOR YEAR ,I4)
    INAME(1)=4HEPHR $ INAME(2) = 4HST
    DO 9 J=3,K
      ENCODE(10,1000,IPTHING)THING(J)
1000 FORMAT(F10.8)
    IF(PTHING(1).EQ.1R )10,11
  10 PTHING(1)=1R0
  11 WRITE(61,501)INAME,(PTHING(M),M=1,10)
    WRITE(62,502)INAME,(PTHING(M),M=1,10)
501 FORMAT(1X,2A4,3X,3HDEC,7X,10R1,3HB26)
502 FORMAT (2A4,3X,3HDEC,7X,10R1,3HB26)
    INAME(1)=INAME(2)=4H
  9 CONTINUE

```

```

      INAME(1)=4HEPHR$INAME(2)=4HSTD1
      DO 12 J=3,K
      WRITE(61,601)INAME,DTHING(J) $ WRITE(62,602)INAME,DTHING(J)
601  FORMAT(1X,2A4,3X,3HDEC,6X,F10.8,3HB28)
602  FORMAT (2A4,3X,3HDEC,6X,F10.8,3HB28)
      INAME(1)=INAME(2)=4H
12   CONTINUE
      INAME(1)=4HEPHI
      DO 13 J=3,K$WRITE(61,701)INAME,DZI(J) $ WRITE(62,702)INAME,DZI(J)
701  FORMAT (1X,2A4,3X,3HDEC,6X,F10.8,3HB26)
702  FORMAT (2A4,3X,3HDEC,6X,F10.8,3HB26)
      INAME(1)=4H
13   CONTINUE
      INAME(1)=4HEPHS $ INAME(2)=4HP
      DO 16 J=3,K
      ENCODE(11,1001,IPTHING)DDOM(J)
1001 FORMAT(F11.8)
      IF(PTHING(1).EQ. 1R ) 14,15
14   PTHING(1)=PTHING(2)=1R0
15   WRITE(61,801)INAME,(PTHING(M),M=1,11)
      WRITE(62,802)INAME,(PTHING(M),M=1,11)
801  FORMAT(1X, 2A4,3X,3HDEC,7X,11R1,3HB26)
802  FORMAT( 2A4,3X,3HDEC,7X,11R1,3HB26)
      INAME(1)=INAME(2)=4H
16   CONTINUE
      STOP
      END

```

FORTRAN DIAGNOSTIC RESULTS FOR MOONKEPH

NO ERRORS
LOAD,56
RUN,50

ACARDIN: 1969

ACARDIN:	1	-21	21.919	186.159	-0.414	259.5351	5.7780	138.6864	239.8968
ACARDIN:	1	-11	21.918	185.595	-0.376	260.6491	5.2485	270.4503	1.8043
ACARDIN:	1	-1	21.916	185.031	-0.338	261.7632	4.7189	42.2143	123.7118
ACARDIN:	1	9	21.915	184.466	-0.300	262.8772	4.1894	173.9783	245.6193
ACARDIN:	1	19	21.914	183.902	-0.263	263.9912	3.6599	305.7422	7.5268
ACARDIN:	1	29	21.913	183.338	-0.225	265.1053	3.1303	77.5062	129.4343
ACARDIN:	2	8	21.913	182.773	-0.187	266.2193	2.6008	209.2702	251.3418
ACARDIN:	2	18	21.912	182.209	-0.149	267.3333	2.0713	341.0341	13.2492
ACARDIN:	2	28	21.912	181.644	-0.111	268.4474	1.5417	112.7981	135.1567
ACARDIN:	3	10	21.911	181.079	-0.073	269.5614	1.0122	244.5620	257.0642
ACARDIN:	3	20	21.911	180.515	-0.035	270.6755	0.4826	16.3260	18.9717
ACARDIN:	3	30	21.911	179.950	0.003	271.7895	359.9531	148.0900	140.8792
ACARDIN:	4	9	21.911	179.385	0.041	272.9035	359.4236	279.8539	262.7867
ACARDIN:	4	19	21.911	178.821	0.079	274.0176	358.8940	51.6179	24.6942
ACARDIN:	4	29	21.912	178.256	0.117	275.1316	358.3645	183.3819	146.6017
ACARDIN:	5	9	21.912	177.691	0.155	276.2456	357.8349	315.1458	268.5092
ACARDIN:	5	19	21.913	177.127	0.193	277.3597	357.3054	86.9098	30.4167
ACARDIN:	5	29	21.913	176.562	0.231	278.4737	356.7759	218.6738	152.3242
ACARDIN:	6	8	21.914	175.998	0.269	279.5878	356.2463	350.4377	274.2317
ACARDIN:	6	18	21.915	175.434	0.307	280.7018	355.7168	122.2017	36.1391
ACARDIN:	6	28	21.916	174.869	0.345	281.8158	355.1873	253.9657	158.0466
ACARDIN:	7	8	21.918	174.305	0.383	282.9299	354.6577	25.7296	279.9541
ACARDIN:	7	18	21.919	173.741	0.421	284.0439	354.1282	157.4936	41.8616
ACARDIN:	7	28	21.921	173.177	0.458	285.1579	353.5986	289.2576	163.7691
ACARDIN:	8	7	21.923	172.612	0.496	286.2720	353.0691	61.0215	285.6766
ACARDIN:	8	17	21.925	172.048	0.534	287.3860	352.5396	192.7855	47.5841
ACARDIN:	8	27	21.927	171.484	0.571	288.5000	352.0100	324.5495	169.4916
ACARDIN:	9	6	21.929	170.920	0.609	289.6141	351.4805	96.3134	291.3991
ACARDIN:	9	16	21.931	170.355	0.646	290.7281	350.9509	228.0774	53.3066
ACARDIN:	9	26	21.934	169.791	0.684	291.8422	350.4214	359.8413	175.2141
ACARDIN:	10	6	21.936	169.227	0.721	292.9562	349.8919	131.6053	297.1216
ACARDIN:	10	16	21.939	168.663	0.758	294.0702	349.3623	263.3693	59.0290
ACARDIN:	10	26	21.942	168.099	0.795	295.1843	348.8328	35.1332	180.9365
ACARDIN:	11	5	21.945	167.536	0.833	296.2983	348.3033	166.8972	302.8440
ACARDIN:	11	15	21.948	166.972	0.870	297.4123	347.7737	298.6612	64.7515
ACARDIN:	11	25	21.951	166.409	0.907	298.5264	347.2442	70.4251	186.6590
ACARDIN:	12	5	21.954	165.845	0.943	299.6404	346.7146	202.1891	308.5665
ACARDIN:	12	15	21.958	165.282	0.980	300.7545	346.1851	333.9531	70.4740
ACARDIN:	12	25	21.961	164.719	1.017	301.8685	345.6556	105.7170	192.3815
ACARDIN:	12	35	21.965	164.156	1.053	302.9825	345.1260	237.4810	314.2890
ACARDIN:	12	45	21.969	163.593	1.090	304.0966	344.5965	9.2450	76.1965
ACARDIN:	12	55	21.973	163.030	1.126	305.2106	344.0669	141.0089	198.1040

EPHCNT EQUALS 38D

EPHDAY -1

COMMENT FOLLOWING VALUES FOR YEAR 1969

EPHRST 3.88381835826

DEC 6.18291439826

DEC 2.19884084826

DEC 4.49795608826

DEC 0.51386682826

DEC 2.81297857826

DEC 5.11207635826

DEC 1.12798535826

DEC 3.42710059826

DEC 5.72619663826

DEC 1.74210563826

DEC 4.04122087826

DEC 0.05713161826

DEC 2.35622765826

EPHR\$TDT

DEC	4.65534114826
DEC	0.67125188826
DEC	2.97036538826
DEC	5.26947887826
DEC	1.28538961826
DEC	3.58450311826
DEC	5.88361660826
DEC	1.89954654826
DEC	4.19864084826
DEC	0.21456903826
DEC	2.51368427826
DEC	4.81279602826
DEC	0.82870851826
DEC	3.12782026826
DEC	5.42693375826
DEC	1.44286369826
DEC	3.74197544826
DEC	6.04110639826
DEC	2.05703633826
DEC	4.35616553826
DEC	0.37209547826
DEC	2.67122642826
DEC	4.97035562826
DEC	0.98630301826
DEC	.04359783828
DEC	.04359783828
DEC	.04359808828
DEC	.04359783828
DEC	.04359786828
DEC	.04359789828
DEC	.04359764828
DEC	.04359789828
DEC	.04359789828
DEC	.04359789828
DEC	.04359764828
DEC	.04359789828
DEC	.04359789828
DEC	.04359764828
DEC	.04359789828
DEC	.04359783828
DEC	.04359808828
DEC	.04359783828
DEC	.04359783828
DEC	.04359805828
DEC	.04359805828
DEC	.04359783828
DEC	.04359783828
DEC	.04359805828
DEC	.04359805828
DEC	.04359783828
DEC	.04359783828
DEC	.04359805828
DEC	.04359802828
DEC	.04359800828
DEC	.04359822828
DEC	.04359819828
DEC	.04359819828
DEC	.04359819828
DEC	.04359816828
DEC	.04359838828
DEC	.04359835828
DEC	.04359835828

EPHI	DEC	.38250636826
	DEC	.38248891826
	DEC	.38247145826
	DEC	.38245400826
	DEC	.38245400826
	DEC	.38243655826
	DEC	.38243655826
	DEC	.38241909826
	DEC	.38241909826
	DEC	.38241909826
	DEC	.38241909826
	DEC	.38243655826
	DEC	.38243655826
	DEC	.38245400826
	DEC	.38245400826
	DEC	.38247145826
	DEC	.38248891826
	DEC	.38250636826
	DEC	.38254127826
	DEC	.38255872826
	DEC	.38259362826
	DEC	.38262853826
	DEC	.38266344826
	DEC	.38269834826
	DEC	.38273325826
	DEC	.38276816826
	DEC	.38282052826
	DEC	.38285542826
	DEC	.38290778826
	DEC	.38296014826
	DEC	.38301250826
	DEC	.38306486826
	DEC	.38311722826
	DEC	.38316958826
	DEC	.38323940826
	DEC	.38329176826
	DEC	.38336157826
EPHSP	DEC	-0.00589921826
	DEC	-0.00523599826
	DEC	-0.00459022826
	DEC	-0.00392699826
	DEC	-0.00326377826
	DEC	-0.00260054826
	DEC	-0.00193732826
	DEC	-0.00127409826
	DEC	-0.00061087826
	DEC	00.00005236826
	DEC	00.000071558826
	DEC	00.00137881826
	DEC	00.00204204826
	DEC	00.00270526826
	DEC	00.00336849826
	DEC	00.00403171826
	DEC	00.00469494826
	DEC	00.00535816826
	DEC	00.00602139826
	DEC	00.00668461826
	DEC	00.00734784826
	DEC	00.00799361826
	DEC	00.00865683826
	DEC	00.00932006826

DEC	00.00996583826
DEC	00.01062906826
DEC	00.01127483826
DEC	00.01193805826
DEC	00.01258382826
DEC	00.01322960826
DEC	00.01387537826
DEC	00.01453859826
DEC	00.01518436826
DEC	00.01583014826
DEC	00.01645845826
DEC	00.01710423826
DEC	00.01775000826
DEC	00.01837832826

I FTN 060 (STOP)

SPURT OUTPUT NO. 110
MOONTRACK P.CROWTHER*20FEB69
NO. OF INSTRUCTIONS 07425
00000 THRU 01453
03652 THRU 07424

SPURT OUTPUT NO. 110

MOONTRACK

P.CROWTHER*20FEB69

CARDS	L1 ID LABEL	TA STATEMENT	LOC	F JKB Y	NOTES
.	00000	MOONTRACK	PROGRAM	P.CROWTHER*20FEB69	
.	00001	MOONUTAG	U-TAG	MOONWORK*MOONINIT	
.	00002		FD	1*MOONP	00000 00243 00005
.	00003	EPHEM	MEANS	C15	00001 22242 42325
.	00004	LUNAR	EQUALS	100	
.	00005	MONITAPE	EQUALS	55	
.	00006	TAPEINPUT	EQUALS	35	
.	00007	EPHEMTAPE	EQUALS	00002	EPHEMERIS TAPE UNIT
.	00010	NUMFILES	EQUALS	120	
.	00011	RECSIZE	EQUALS	80	
.	00012	AREACNT	EQUALS	11650	
.	00013		COMMENT	AREACNT = CNT TO RE CLEARED	
.				BETWEEN YREMAIN AND LASTEPHEM	
.	00014	CELMOON	FD	3*OBJECT MOON	00002 24071 71210
.					00003 31052 22424
.					00004 23050 50505
.	00015	MOONINIT	ENTRY		00005 61000 00000
.	00016		MOVE	3*CELMOON*CELBODY	00006 10030 00002
.					00007 14030 63113
.					00010 10030 00003
.					00011 14030 63114
.					00012 10030 00004
.					00013 14030 63115
.	00017		ENT	A**W(IGNORE)	00014 11030 01051
.	00020		STR	A**W(MONITAPE)	00015 15030 00055
.	00021		ENT	A**W(INTERUPT)	00016 11030 01052
.	00022		STR	A**W(TAPEINPUT)	00017 15030 00035
.	00023		CLEAR	AREACNT*YRREMAIN	00020 70100 02215
.					00021 16030 01436
.	00024		ENT	Q**W(EQUATOR)	00022 10030 63323 B17
.	00025		MUL	W(RHRSEC)	00023 22030 01066
.	00026		LSH	AQ*1*QPOS	00024 07200 00001
.	00027		ADD	A*1	00025 20000 00001
.	00030		STR	A**W(ERNMSEC)	00026 15030 01065 B28
.	00031		ENT	A*U(YEARMONTH)	00027 11020 63147
.	00032		SUB	A*19610	00030 21000 03651
.	00033		STR	A**W(MONTHPRINT)	00031 15030 01032
.	00034		RSH	AQ*300	00032 03000 00036
.	00035		DIV	4	00033 23000 00004
.	00036		STR	A**W(YRREMAIN)	00034 15030 01436 (0,1,2,3)
.	00037		MUL	14610	00035 22000 02665 DAYS IN 4 YRS
.	00040		STR	Q**W(WHOLEYEAR)	00036 14030 01437
.	00041		ENT	Q**W(YRREMAIN)	00037 10030 01436
.	00042		MUL	3650	00040 22000 00555
.	00043		RPL	Y+Q**W(WHOLEYEAR)	00041 34030 01437
.	00044		RJP	DAYFIND	00042 65000 00437
.	00045		CL	W(IMPERIAL)	00043 16030 01441 SET EOF COUNT = 0
.	00046	TRYAGAIN	ENT	A**W(SAFE)	00044 11030 01452
.	00047		STR	A**W(TAPEBLOCK)	00045 15030 01442
.	00050		IN	EPHEM**W(EPHEMA)	00046 73670 03653
.	00051		SUB	A*3	00047 21000 00003 IDENT-3
.	00052		EX-FCT	EPHEM**W(SRHIBIN)	00050 13670 01050

00053	STR A*L(TAPESEARCH)	00051	15010	03661
00054	EX-FCT EPHEM*W(TAPESEARCH)	00052	13670	03661
00055	JP \$	00053	61000	00053
00056	IN EPHEM*W(EPHEMB)	00054	73670	03654
00057	RPL Y+1*W(TAPESEARCH)	00055	36030	03661
00060	EX-FCT EPHEM*W(SRHIBIN)	00056	13670	01050
00061	NO-OP	00057	12000	00000
00062	EX-FCT EPHEM*W(TAPESEARCH)	00060	13670	03661
00063	JP \$	00061	61000	00061
00064	IN EPHEM*W(EPHEMC)	00062	73670	03655
00065	RPL Y+1*W(TAPESEARCH)	00063	36030	03661
00066	EX-FCT EPHEM*W(SRHIBIN)	00064	13670	01050
00067	NO-OP	00065	12000	00000
00070	EX-FCT EPHEM*W(TAPESEARCH)	00066	13670	03661
00071	JP \$	00067	61000	00067
00072	IN EPHEM*W(EPHEMD)	00070	73670	03656
00073	RPL Y+1*W(TAPESEARCH)	00071	36030	03661
00074	EX-FCT EPHEM*W(SRHIBIN)	00072	13670	01050
00075	NO-OP	00073	12000	00000
00076	EX-FCT EPHEM*W(TAPESEARCH)	00074	13670	03661
00077	JP \$	00075	61000	00075
00100	IN EPHEM*W(EPHEME)	00076	73670	03657
00101	RPL Y+1*W(TAPESEARCH)	00077	36030	03661
00102	EX-FCT EPHEM*W(SRHIBIN)	00100	13670	01050
00103	NO-OP	00101	12000	00000
00104	EX-FCT EPHEM*W(TAPESEARCH)	00102	13670	03661
00105	JP \$	00103	61000	00103
00106	IN EPHEM*W(EPHEMF)	00104	73670	03660
00107	RPL Y+1*W(TAPESEARCH)	00105	36030	03661
00110	EX-FCT EPHEM*W(SRHIBIN)	00106	13670	01050
00111	NO-OP	00107	12000	00000
00112	EX-FCT EPHEM*W(TAPESEARCH)	00110	13670	03661
00113	JP \$	00111	61000	00111
00114	EX-FCT EPHEM*W(REWINDNO)	00112	13670	01053
00115	JP \$	00113	61000	00113
00116	RJP MOONTIME	00114	65000	00504
00117	ENT B4*L(RAAD)	00115	12410	01443
00120	ENT A*L(RADIFAD)	00116	11010	01444
00121	RJP INTERPOL	00117	65000	01136
00122	ENT Q*0*ANEG	00120	10700	00000
00123	SUB A*W(TWOPIE)*AP0S	00121	21630	01067
00124	ADD A*W(TWOPIE)	00122	20030	01067
00125	RSH AQ*27D	00123	03000	00033
00126	DIV W(HRAD)	00124	23030	01056
00127	STR Q*W(RA2)	00125	14030	00710
00130	CL Q	00126	10000	00000
00131	RSH AQ*23D	00127	03000	00027
00132	DIV W(MINSRAD)	00130	23030	01057
00133	STR Q*W(RA4)	00131	14030	00713
00134	RSH AQ*30D	00132	03000	00036
00135	MUL W(SRAD)	00133	22030	01055
00136	LSH AQ*2*QPO5	00134	07200	00002
00137	ADD A*1	00135	20000	00001
00140	STR A*W(RA6)	00136	15030	00716
00141	ENT B4*L(DECAD)	00137	12410	01445
00142	ENT A*L(DECDFAD)	00140	11010	01446
00143	RJP INTERPOL	00141	65000	01136
00144	STR A*W(GMT2)	00142	15030	00776
00145	ENT Q*0*AP0S	00143	10600	00000

NORMAL

WAIT FOR INTERRUPT

•	00146	CP	A	00144	15040	00000	
•	00147	RSH	AQ*22D	00145	03000	00026	
•	00150	DIV	W(MINSRAD)	00146	23030	01057	
•	00151	STR	Q*W(DLN2)	00147	14030	00743	
•	00152	CL	Q	00150	10000	00000	
•	00153	RSH	AQ*24D	00151	03000	00030	
•	00154	DIV	W(SECSRAD)	00152	23030	01063	
•	00155	STR	Q*W(DLN4)	00153	14030	00746	
•	00156	RSH	AQ*30D	00154	03000	00036	
•	00157	MUL	W(SARAD)	00155	22030	01064	
•	00160	LSH	AQ*2*QP05	00156	07200	00002	
•	00161	ADD	A*1	00157	20000	00001	
•	00162	STR	A*W(DLN6)	00160	15030	00751	
•	00163	ENT	A*W(GMT2)*ANEG	00161	11730	00776	
•	00164	JP	S+3	00162	61000	00165	
•	00165	ENT	A*W(DLN2)	00163	11030	00743	
•	00166	STR	A*CPW(DLN2)	00164	15070	00743	
•	00167	ENT	A*W(CELTIME)	00165	11030	63133	
•	00170	ENT	Q*0*AP05	00166	10600	00000	
•	00171	CP	A	00167	15040	00000	
•	00172	RSH	AQ*26D	00170	03000	00032	
•	00173	DIV	W(HDAY)	00171	23030	01060	
•	00174	STR	Q*W(GMT2)	00172	14030	00776	
•	00175	CL	Q	00173	10000	00000	
•	00176	RSH	AQ*23D	00174	03000	00027	
•	00177	DIV	W(MDAY)	00175	23030	01061	
•	00200	STR	Q*W(GMT4)	00176	14030	01001	
•	00201	RSH	AQ*30D	00177	03000	00036	
•	00202	MUL	W(SDAY)	00200	22030	01062	
•	00203	LSH	AQ*2*QP05	00201	07200	00002	
•	00204	ADD	A*1	00202	20000	00001	
•	00205	STR	A*W(GMT6)	00203	15030	01004	
•	00206	ENT	A*W(CELTIME)*ANEG	00204	11730	63133	
•	00207	JP	S+3	00205	61000	00210	
•	00210	ENT	A*W(GMT2)	00206	11030	00776	
•	00211	STR	A*CPW(GMT2)	00207	15070	00776	
•	00212	ENT	B4*L(DISTAD)	00210	12410	01447	
•	00213	ENT	A*L(DISTDIFAD)	00211	11010	01450	
•	00214	STR	A*L(SETINTAD)	00212	15010	01135	
•	00215	RJP	INTERPOL	00213	65000	01136	
•	00216	STR	A*W(INITIAL18)	00214	15030	01017	
•	00217	ENT	A*W(JULIANDAY)	00215	11030	01440	
•	00220	STR	A*W(INITIAL3)	00216	15030	00654	
•	00221	ENT	A*L(DAY)	00217	11010	63150	
•	00222	STR	A*W(INITIAL12)	00220	15030	00665	
•	00223	PRINT	ENT A*U(KYBRDLEVEL)*AZERO	00221	11420	63110	DO WE USE CONSOLE TYPEWRITE
•	00224	JP	AIRPORT	00222	61000	00237	NO
•	00225	RJP	U(INTERCOM)	00223	65020	63426	
•	00226	U-TAG	RGHTASC*0	00224	00666	00000	
•	00227	RJP	U(INTERCOM)	00225	65020	63426	
•	00230	U-TAG	DLN*0	00226	00721	00000	
•	00231	RJP	U(INTERCOM)	00227	65020	63426	
•	00232	U-TAG	INITIALDAT*0	00230	00655	00000	
•	00233	RJP	U(INTERCOM)	00231	65020	63426	
•	00234	U-TAG	GMT*0	00232	00754	00000	
•	00235	RJP	U(INTERCOM)	00233	65020	63426	
•	00236	U-TAG	INITIALDIS*0	00234	01007	00000	
•	00237	RJP	U(INTERCOM)	00235	65020	63426	
•	00240	U-TAG	INITIALBOD*0	00236	01020	00000	

•	00241 AIRPORT	NO-UP	00237	12000	00000	
•	00242	RJP MXINIT	00240	65000	03662	INITIALIZE OFFSET
•	00243	RPL Y+1*L(MOONINIT)	00241	36010	00005	SET FOR NORMAL EXIT
•	00244	EXIT	00242	61010	00005	EXIT FROM INITIALIZATION
•	00245	COMMENT				
•	00246	COMMENT				
•	00247	COMMENT				
•	00250 MOONWORK	ENTRY	00243	61000	00000	
•	00251	RPL Y+1*L(MOONWORK)	00244	36010	00243	SET FOR NORMAL EXIT
•	00252	RJP MOONTIME	00245	65000	00504	
•	00253 HARVARD	ENT B4*L(RAAD)	00246	12410	01443	
•	00254	ENT A*L(RADIFAD)	00247	11010	01444	
•	00255	RJP INTERPOL	00250	65000	01136	
•	00256	STR A*W(MKRA)	00251	15030	06643	
•	00257	ENT Q*W(MKRA)	00252	10030	06643	
•	00260	MUL W(REVSRADIAN)	00253	22030	01047	
•	00261	RJP ROUND	00254	65000	01426	
•	00262	STR A*W(RA)	00255	15030	63002	
•	00263	ENT Q*W(NUMDERIV)	00256	10030	01127	
•	00264	MUL W(RHRSEC)	00257	22030	01066	B 40
•	00265	LSH AQ*1	00260	07000	00001	
•	00266	STR A*W(RADOT)	00261	15030	63007	B37 RADS/SEC
•	00267	LSH AQ*5	00262	07000	00005	AT B42
•	00270	RJP ROUND	00263	65000	01426	
•	00271	STR A*W(MKRADOT)	00264	15030	06641	
•	00272	ENT B4*L(DECAD)	00265	12410	01445	
•	00273	ENT A*L(DECDFAD)	00266	11010	01446	
•	00274	RJP INTERPOL	00267	65000	01136	
•	00275	STR A*W(MKDEC)	00270	15030	06644	
•	00276	STR A*W(DECLINRAD)*SKIP	00271	15130	00272	SAVE DECLINATION IN RADIAN
•	00277 DECLINRAD	0	00272	00000	00000	DEC IN RAD AT B26
•	00300	ENT Q*26D	00273	10000	00032	
•	00301	RJP COS	00274	65000	06343	GET COS AT B28
•	00302	RSH AQ*30D	00275	03000	00036	TO Q AT B28
•	00303	MUL W(RADOT)	00276	22030	63007	*RADOT AT B(N)
•	00304	LSH AQ*2	00277	07000	00002	
•	00305	RJP ROUND	00300	65000	01426	
•	00306	STR A*W(RADOT)	00301	15030	63007	NEW RADOT IS (COS(DECL)*RADOT)
•	00307	ENT Q*W(DECLINRAD)	00302	10030	00272	DEC IN RAD AT B26
•	00310	MUL W(REVSRADIAN)	00303	22030	01047	IN REV AT B26+B31=B57
•	00311	RJP ROUND	00304	65000	01426	
•	00312	STR A*W(DEC)	00305	15030	63003	DEC IN REV AT B27
•	00313	ENT Q*W(NUMDERIV)	00306	10030	01127	
•	00314	MUL W(RHRSEC)	00307	22030	01066	
•	00315	LSH AQ*1	00310	07000	00001	
•	00316	STR A*W(DECDDOT)	00311	15030	63010	B37 RADS/SEC
•	00317	LSH AQ*5	00312	07000	00005	AT B42
•	00320	RJP ROUND	00313	65000	01426	
•	00321	STR A*W(MKDECDDOT)	00314	15030	06642	
•	00322	ENT B4*L(DISTAD)	00315	12410	01447	
•	00323	ENT A*L(DISTDFAD)	00316	11010	01450	
•	00324	RJP INTERPOL	00317	65000	01136	
•	00325	STR A*W(RADIUS)	00320	15030	63006	B22
•	00326	STR A*W(MKDDO)	00321	15030	06645	IN E.P. AT B22
•	00327	ENT Q*W(NUMDERIV)	00322	10030	01127	
•	00330	MUL W(ERNMSEC)	00323	22030	01065	
•	00331	LSH AQ*4	00324	07000	00004	IN NM/SEC AT B24
•	00332	STR A*W(RADIUSDOT)	00325	15030	63011	B24

•	00333	LSH	AQ*5	00326	07000	00005	AT B29
•	00334	RJP	ROUND	00327	65000	01426	
•	00335	STR	A*W(MKDDOT)	00330	15030	06654	
•	00336	ENT	Q*A	00331	10070	00000	
•	00337	MUL	W(MKQERPNI)	00332	22030	06631	
•	00340	LSH	AQ*1	00333	07000	00001	
•	00341	RJP	ROUND	00334	65000	01426	
•	00342	STR	A*W(MKDDOTX)	00335	15030	06655	
•	00343	ENT	A*W(MOONSW5)*ANOT	00336	11530	63343	INCLUDE OFFSET
•	00344	EXIT		00337	61010	00243	NO, EXIT FROM MOONWORK
•	00345	COMMENT	INTERPOLATE EPHMERIS TAB				
		LE					
•	00346	COMMENT	DAY=EPHDAY=K+R				
•	00347	COMMENT	CELTIME+R)/10=P TIME FOR INT				
		ERPULATE	B27				
•	00350	COMMENT	EPH(P)=(EPH(K+1)-EPH(K))P+EPH(K)				
•	00351	RPL	Y-1*W(MKDELAYCNT)*ANEG	00340	37730	07022	
•	00352	EXIT		00341	61010	00243	NO OFFSET YET
•	00353	STR	B1*L(MKB1STOR)	00342	16110	00435	
•	00354	CL	A	00343	11000	00000	
•	00355	ENT	Q*L(DAY)	00344	10010	63150	
•	00356	SUB	Q*LX(EPHDAY)*QPOS	00345	27650	07170	
•	00357	O	O	00346	00000	00000	
•	00360	DIV	10D*N00F	00347	23200	00012	
•	00361	RJP	SOVERFLOW	00350	65000	06257	
•	00362	LSH	AQ*30D	00351	07000	00036	
•	00363	ENT	B7*A	00352	12770	00000	
•	00364	LSH	Q*25D	00353	05000	00031	
•	00365	ENT	A*W(CELTIME)	00354	11030	63133	
•	00366	RSH	A*3	00355	02000	00003	
•	00367	STR	A+Q*W(MKT1)	00356	32030	07000	
•	00370	CL	Q	00357	10000	00000	
•	00371	RSH	AQ*3	00360	03000	00003	
•	00372	DIV	W(TENB25)*N00F	00361	23230	06622	
•	00373	RJP	SOVERFLOW	00362	65000	06257	
•	00374	STR	Q*W(EPHP)	00363	14030	07160	
•	00375	COMMENT	COMPUTE MKQKI, MKQSDT, MKQI, MKQSP				
•	00376	PUT	W(TWOPIE)*W(MOD2PI)	00364	10030	01067	
				00365	14030	07161	
•	00377	BSK	B1*B1	00366	71101	00000	
•	00400	EPHINTERP	ENT B7*EPHCNT+B7	00367	12707	00046	
•	00401	ENT	Q*W(EPHRST+1+B7)	00370	10037	07172	
•	00402	SUB	Q*W(EPHRST+B7)*QPOS	00371	27637	07171	
•	00403	ADD	Q*W(MOD2PI)	00372	26030	07161	2*PI AT B26
•	00404	MUL	W(EPHP)	00373	22030	07160	
•	00405	LSH	AQ*3	00374	07000	00003	
•	00406	RJP	ROUND	00375	65000	01426	
•	00407	SUB	A*W(MOD2PI)	00376	21030	07161	
•	00410	ADD	A*W(EPHRST+B7)*APOS	00377	20637	07171	
•	00411	ADD	A*W(MOD2PI)	00400	20030	07161	
•	00412	STR	A*W(MKQK1+B1)	00401	15031	07162	
•	00413	CL	W(MOD2PI)	00402	16030	07161	
•	00414	BSK	B1*3	00403	71100	00003	
•	00415	JP	EPHINTERP	00404	61000	00367	
•	00416	RJP	MXLHA	00405	65000	04202	
•	00417	RJP	MXRO	00406	65000	04220	
•	00420	RJP	MXRODT	00407	65000	04351	

•	00421	RJP	MXDOP	00410	65000	04472	
•	00422	RJP	MXA	00411	65000	04517	
•	00423	RJP	MXB	00412	65000	04553	
•	00424	RJP	MXC	00413	65000	04625	
•	00425	RJP	MXDELP	00414	65000	04661	
•	00426	RJP	MXALF	00415	65000	04677	
•	00427	RJP	MXDECPDT	00416	65000	04740	
•	00430	RJP	MXAPDT	00417	65000	05017	
•	00431	RJP	MXA1	00420	65000	05055	
•	00432	RJP	MXB1	00421	65000	05146	
•	00433	RJP	MXC1	00422	65000	05230	
•	00434	RJP	MXSINBP	00423	65000	05312	
•	00435	RJP	MXSINLP	00424	65000	05327	
•	00436	RJP	MXSINCP	00425	65000	05375	
•	00437	RJP	MXBPD	00426	65000	05413	
•	00440	RJP	MXLPDT	00427	65000	05424	
•	00441	RJP	MXFCL	00430	65000	05466	
•	00442	RJP	MXDA	00431	65000	05543	
•	00443	RJP	MXXYZ	00432	65000	05563	
•	00444	RJP	MXDELALF	00433	65000	05674	
•	00445	RJP	MXDPDOP	00434	65000	05761	
•	00446	MKB1STOR	ENT B1*00	00435	12100	00000	
•	00447		EXIT	00436	61010	00243	EXIT FROM MOONWORK
•	00450	DAYFIND	ENTKY	00437	61000	00000	
•	00451		ENT A*W(CELTIME)*ANEG	00440	11730	63133	
•	00452		JP FLATPOS	00441	61000	00456	
•	00453	FLATNEG	CP A	00442	15040	00000	
•	00454		SUB A*W(HALFDAY)*APOS	00443	21630	01046	
•	00455		JP LESSONE	00444	61000	00460	
•	00456		RSH AQ*30D	00445	03000	00036	
•	00457		DIV W(HALFDAY)	00446	23030	01046	
•	00460		LSH AQ*30D	00447	07000	00036	
•	00461		SUB A*1	00450	21000	00001	
•	00462		JP TWOLESS*AZERO	00451	60400	00454	
•	00463		JP TWOLESS*ANEG	00452	60700	00454	
•	00464		ENT A*-3*SKIP	00453	11140	77774	
•	00465	TWOLESS	ENT A*-2	00454	11040	77775	
•	00466		JP STORE	00455	61000	00472	
•	00467	FLATPOS	SUB A*W(HALFDAY)*ANEG	00456	21730	01046	
•	00470		JP MOREONE	00457	61000	00462	
•	00471	LESSONE	ENT A*-1	00460	11040	77776	
•	00472		JP STORE	00461	61000	00472	
•	00473	MOREONE	RSH AQ*30D	00462	03000	00036	
•	00474		DIV W(HALFDAY)	00463	23030	01046	
•	00475		LSH AQ*30D	00464	07000	00036	
•	00476		SUB A*1	00465	21000	00001	
•	00477		JP CERO*AZERO	00466	60400	00471	
•	00500		JP CERO*ANEG	00467	60700	00471	
•	00501		ENT A*1*SKIP	00470	11100	00001	
•	00502	CERO	ENT A*0	00471	11000	00000	
•	00503	STORE	STR A*W(DAYINCRMT)	00472	15030	00503	
•	00504		ADD A*W(WHOLEYEAR)	00473	20030	01437	
•	00505		ADD A*2437300D	00474	20030	07421	JD DEC 31 1960 GNWCH NOON
•	00506		ADD A*L(DAY)	00475	20010	63150	
•	00507		STR A*W(JULIANDAY)	00476	15030	01440	
•	00510		SUB A*2438145D	00477	21030	07422	JD APR 25 1963 GNWCH NOON
•	00511		SUB A*W(DAYINCRMT)	00500	21030	00503	
•	00512		STR A*W(SAFE)	00501	15030	01452	
•	00513		EXIT	00502	61010	00437	

• 00514 DAYINCRMNT	0	00503 00000 00000	
• 00515 MOUNTIME	ENTRY	00504 61000 00000	
• 00516	CL B4	00505 12400 00000	
• 00517	ENT A*W(CELTIME)	00506 11030 63133	
• 00520	ADD A*W(DELTAEE)*APUS	00507 20630 63316	
• 00521	SUB A*W(KEY)*SKIP	00510 21130 01101	
• 00522	ENT B4*5760	00511 12400 01100	
• 00523	RSH AQ*300	00512 03000 00036	
• 00524	DIV W(HOUR)	00513 23030 01054	
• 00525	STR Q*W(TIME2)	00514 14030 01451	
• 00526	CL Q	00515 10000 00000	
• 00527	DIV W(HOUR)	00516 23030 01054	
• 00530	LSH AQ*290	00517 07000 00035	
• 00531	SEL CL*W(KEY)	00520 52030 01101	
• 00532	STR A*W(P)	00521 15030 01110	
• 00533	ENT Q*W(TIME2)	00522 10030 01451	
• 00534	MUL RECSIZE	00523 22000 00010	
• 00535	STR Q*A	00524 14040 00000	
• 00536	ADD A*AEPHEM+2+B4	00525 20004 01455	
• 00537	STR A*L(RAAD)	00526 15010 01443	
• 00540	ENT Q*1	00527 10000 00001	
• 00541	RPT 5*ADV	00530 70100 00005	
• 00542	STR A+Q*L(RADIFAD)	00531 32010 01444	
• 00543	EXIT	00532 61010 00504	
• 00544 STATUSCK	ENTRY	00533 61000 00000	
• 00545	RPL Y+1*L(STATUSCK)	00534 36010 00533	
• 00546	STR EPHEM*W(TAPSTAT)	00535 17670 00624	
• 00547	ENT A*U(TAPSTAT)	00536 11020 00624	
• 00550	RSH A*90	00537 02000 00011	
• 00551	SEL CL*3	00540 52000 00003	
• 00552	STR A*W(TAPSTAT+1)	00541 15030 00625	
• 00553	SUB A*24*ANOT	00542 21500 00024	
• 00554	RILJP TRYAGAIN	00543 60100 00044	TAPE IS REWINDING
• 00555	SUB A*14*ANOT	00544 21500 00014	
• 00556	RILJP L(STATUSCK)	00545 60110 00533	EXIT, STATUS = 40
• 00557	SUB A*14*AZERO	00546 21400 00014	54 = EOF
• 00560	RILJP BUST	00547 60100 00602	TAPE ERROR
• 00561	RPL Y+1*L(IMPERIAL)	00550 36010 01441	EOF FOUND
• 00562	SUB A*NUMFILES*AZERO	00551 21400 00014	
• 00563	RILJP TRYAGAIN	00552 60100 00044	SEARCH NEXT FILE
• 00564	ENT B4*L(MONTHPRINT)	00553 12410 01032	
• 00565	ENT A*W(YEARPRINT+B4)	00554 11034 01070	
• 00566	ENT B4*L(YEARMONTH)	00555 12410 63147	
• 00567	ADD A*W(MONTHPRINT-1+B4)	00556 20034 01031	
• 00570	STR A*W(NODATA2)	00557 15030 00635	
• 00571	CL A	00560 11000 00000	
• 00572	ENT G*NUMFILES	00561 10000 00014	
• 00573	DIV 12	00562 23000 00012	
• 00574	ADD A*60	00563 20000 00060	
• 00575	STR A*U(IMPERIAL)	00564 15020 01441	
• 00576	STR Q*A*AZERO	00565 14440 00000	
• 00577	ADD A*60	00566 20000 00060	
• 00600	LSH A*6	00567 06000 00006	
• 00601	ADD A*U(IMPERIAL)	00570 20020 01441	
• 00602	LSH A*6	00571 06000 00006	
• 00603	ADD A*3105000005	00572 20030 07423	
• 00604	STR A*W(NODATA2+4)	00573 15030 00641	
• 00605	RIL	00574 60000 00000	
• 00606	RJP U(INTERCOM)	00575 65020 63426	

•	00607	U-TAG	NODATA*0	00576	00627	00000	
•	00610	EX-FCT	EPHEM*W(REWINDNO)	00577	13670	01053	
•	00611	JP	\$	00600	61000	00600	WAIT FOR INTERRUPT
•	00612	JP	L(MOONINIT)	00601	61010	00005	ERROR EXIT
•	00613 BUST	ENT	A*L(TAPSTAT+1)	00602	11010	00625	
•	00614	RSR	AQ*3	00603	03000	00003	
•	00615	LSH	A*3	00604	06000	00003	
•	00616	LSH	AQ*3	00605	07000	00003	
•	00617	ADD	A*6060	00606	20000	06060	
•	00620	STR	A*L(TAPEBUST1+3)	00607	15010	00622	
•	00621	RJP	U(INTERCOM)	00610	65020	63426	
•	00622	U-TAG	TAPEBUST*0	00611	00615	00000	
•	00623	EX-FCT	EPHEM*W(REWINDNO)	00612	13670	01053	
•	00624	JP	\$	00613	61000	00613	WAIT FOR INTERRUPT
•	00625	JP	L(MOONINIT)	00614	61010	00005	ERROR EXIT
•	00626 TAPEBUST	FD	1*A	00615	06050	50505	
•	00627	-0	\$+1	00616	77777	00617	
•	00630 TAPEBUST1	FD	4*TAPE STATUS(S1)=	00617	31062	51205	
				00620	30310	63132	
				00621	30513	06140	
				00622	44050	50505	
•	00631	-0	-0	00623	77777	77777	
•	00632 TAPSTAT	+0		00624	00000	00000	
•	00633	+0		00625	00000	00000	
•	00634	+0		00626	00000	00000	
•	00635 NODATA	FD	1*A	00627	06050	50505	
•	00636	-0	\$+1	00630	77777	00631	
•	00637	FD	4*MOON EPHEMERIS FOR	00631	22242	42305	
				00632	12251	51222	
				00633	12271	63005	
				00634	13242	70505	
•	00640 NODATA2	FD	6* DATE NOT AMONG FIRST FILES	00635	05110	63112	
				00636	05232	43105	
				00637	06222	42314	
				00640	05131	62730	
				00641	31050	50505	
				00642	13162	11230	
•	00641	-0		00643	77777	77777	
•	00642 INITIALJD	FD	1*A	00644	06050	50505	
•	00643	U-TAG	INITIAL2*\$+1	00645	00652	00646	
•	00644	FD	3*JULIAN DAY	00646	17322	11606	
				00647	23051	10636	
				00650	05050	50505	
•	00645	-0		00651	77777	77777	
•	00646 INITIAL2	FD	1*D	00652	11050	50505	
•	00647	-0	INITIAL3	00653	77777	00654	
•	00650 INITIAL3	0		00654	00000	00000	
•	00651 INITIALDAT	FD	1*A	00655	06050	50505	
•	00652	U-TAG	INITIAL11*\$+1	00656	00663	00657	
•	00653	FD	3*DAY OF YEAR	00657	11063	60524	
				00660	13053	61206	
				00661	27050	50505	
•	00654	-0	-0	00662	77777	77777	
•	00655 INITIAL11	FD	1*D	00663	11050	50505	
•	00656	-0	INITIAL12	00664	77777	00665	
•	00657 INITIAL12	0		00665	00000	00000	
•	00660 RGHTASC	FD	1*A	00666	06050	50505	
•	00661	0	RA1	00667	00000	00704	
•	00662	FD	1*D	00670	11050	50505	

•	00663	0	RA2
•	00664	FD	1*A
•	00665	0	RA3
•	00666	FD	1*D
•	00667	0	RA4
•	00670	FD	1*A
•	00671	0	RA5
•	00672	FD	1*X2B23
•	00673	0	RA6
•	00674	FD	1*A
•	00675	-0	RA7
•	00676 RA1	FD	3*RIGHT ASC
•	00677	-0	
•	00700 RA2	0	
•	00701 RA3	0015050000	
•	00702	-0	
•	00703 RA4	0	
•	00704 RA5	0022050000	
•	00705	-0	
•	00706 RA6	0	
•	00707 RA7	0030000000	
•	00710	-0	
•	00711 DLN	FD	1*A
•	00712	0	DLN1
•	00713	FD	1*D
•	00714	0	DLN2
•	00715	FD	1*A
•	00716	0	DLN3
•	00717	FD	1*D
•	00720	0	DLN4
•	00721	FD	1*A
•	00722	0	DLN5
•	00723	FD	1*X2B23
•	00724	0	DLN6
•	00725	FD	1*A
•	00726	-0	DLN7
•	00727 DLN1	FD	3*DECLINATION
•	00730	-0	
•	00731 DLN2	0	
•	00732 DLN3	0011050000	
•	00733	-0	
•	00734 DLN4	0	
•	00735 DLN5	0072050000	
•	00736	-0	
•	00737 DLN6	0	
•	00740 DLN7	0052000000	
•	00741	-0	
•	00742 GMT	FD	1*A
•	00743	0	GMT1
•	00744	FD	1*D
•	00745	0	GMT2
•	00746	FD	1*A
•	00747	0	GMT3
•	00750	FD	1*D
•	00751	0	GMT4

00671	00000	00710	
00672	06050	50505	
00673	00000	00711	
00674	11050	50505	
00675	00000	00713	
00676	06050	50505	
00677	00000	00714	
00700	35620	76263	
00701	00000	00716	
00702	06050	50505	
00703	77777	00717	
00704	27161	41531	
00705	05063	01005	
00706	05050	50505	
00707	77777	77777	
00710	00000	00000	
00711	00150	50000	H(HOUR)
00712	77777	77777	
00713	00000	00000	
00714	00220	50000	M(MIN)
00715	77777	77777	
00716	00000	00000	
00717	00300	00000	S(SEC)
00720	77777	77777	
00721	06050	50505	
00722	00000	00737	
00723	11050	50505	
00724	00000	00743	
00725	06050	50505	
00726	00000	00744	
00727	11050	50505	
00730	00000	00746	
00731	06050	50505	
00732	00000	00747	
00733	35620	76263	
00734	00000	00751	
00735	06050	50505	
00736	77777	00752	
00737	11121	02116	
00740	23063	11624	
00741	23050	50505	
00742	77777	77777	
00743	00000	00000	
00744	00110	50000	D(DEG)
00745	77777	77777	
00746	00000	00000	
00747	00720	50000	(MIN)
00750	77777	77777	
00751	00000	00000	
00752	00520	00000	(SEC)
00753	77777	77777	
00754	06050	50505	
00755	00000	00772	
00756	11050	50505	
00757	00000	00776	
00760	06050	50505	
00761	00000	00777	
00762	11050	50505	
00763	00000	01001	

• 00752	FD 1*A	00764	06050 50505	
• 00753	0 GMT5	00765	00000 01002	
• 00754	FD 1*X2B23	00766	35620 76263	
• 00755	0 GMT6	00767	00000 01004	
• 00756	FD 1*A	00770	06050 50505	
• 00757	-0 GMT7	00771	77777 01005	
• 00760 GMT1	FD 3*UNIVERSAL TIME	00772	32231 63312	
		00773	27300 62105	
		00774	31162 21205	
• 00761	-0	00775	77777 77777	
• 00762 GMT2	0	00776	00000 00000	
• 00763 GMT3	0015050000	00777	00150 50000	H(HOUR)
• 00764	-0	01000	77777 77777	
• 00765 GMT4	0	01001	00000 00000	
• 00766 GMT5	0022050000	01002	00220 50000	M(MIN)
• 00767	-0	01003	77777 77777	
• 00770 GMT6	0	01004	00000 00000	
• 00771 GMT7	0030000000	01005	00300 00000	S(SEC)
• 00772	-0	01006	77777 77777	
• 00773 INITIALDIS	FD 1*A	01007	06050 50505	
• 00774	U-TAG INITIAL17*\$+1	01010	01015 01011	
• 00775	FD 3*DISTANCE(E.R.)	01011	11163 03106	
		01012	23101 25112	
		01013	75277 54005	
• 00776	-0	01014	77777 77777	
• 00777 INITIAL17	FD 1*X6B22	01015	35660 76262	
• 01000	-0 INITIAL18	01016	77777 01017	
• 01001 INITIAL18	0	01017	00000 00000	
• 01002 INITIALBOD	FD 1*A	01020	06050 50505	
• 01003	U-TAG INITIAL20*\$+1	01021	01026 01022	
• 01004	FD 3*OBJECT	01022	24071 71210	
		01023	31050 50505	
		01024	05050 50505	
• 01005	-0	01025	77777 77777	
• 01006 INITIAL20	FD 1*A	01026	06050 50505	
• 01007	-0 \$+1	01027	77777 01030	
• 01010	FD 0*MOON	01030	22242 42300	
• 01011	-0	01031	77777 77777	
• 01012 MONTHPRINT	0061000000	01032	00610 00000	
• 01013	0062000000	01033	00620 00000	
• 01014	0063000000	01034	00630 00000	
• 01015	0064000000	01035	00640 00000	
• 01016	0065000000	01036	00650 00000	
• 01017	0066000000	01037	00660 00000	
• 01020	0067000000	01040	00670 00000	
• 01021	0070000000	01041	00700 00000	
• 01022	0071000000	01042	00710 00000	
• 01023	6160000000	01043	61600 00000	
• 01024	6161000000	01044	61610 00000	
• 01025	6162000000	01045	61620 00000	
• 01026 HALFDAY	1000000000	01046	10000 00000	
• 01027 REVS RADIAN	2427630155	01047	24276 30155	.636619772B29 2/PI
• 01030 SRHIBIN	56000 EPHEMTAPE	01050	56000 00002	SEARCH EPHEMERIS TAPE HD,RIN W /I
• 01031 IGNORE	6000000000	01051	60000 00000	
• 01032 INTERRUPT	RJP STATUSCK	01052	65000 00533	
• 01033	COMMENT SEE MOON WRITEUP FOR DESCRIPTI ON OF FOLLOWING CONSTANTS			
• 01034 REWINDNO	30100 EPHEMTAPE	01053	30100 00002	REWIND EPHEMERIS TAPE W/INTERR


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. 01035 HOUR 0052525253
. 01036 SRAD 3266677130
. 01037 HRAD 1030124434
. 01040 MINSRAD 2167643242
. 01041 HDAY 1252525252
. 01042 MDAY 2660266026
. 01043 SDAY 2506000000
. 01044 SECSRAD 2304045527
. 01045 SARAD 3113343163
. 01046 ERNMSEC 0
. 01047 RHRSEC 2215053170
. 01050 TWOPIE 3110375524
. 01051 COMMENT INCLUDES 1961-1969
. 01052 YEARPRINT 0000746661
. 01053 0000746662
. 01054 0000746663
. 01055 0000746664
. 01056 0000746665
. 01057 0000746666
. 01060 0000746667
. 01061 0000746670
. 01062 0000746671
. 01063 KEY 4000000000
. 01064 FIRSTDIFF 0
. 01065 BETA 0
. 01066 GAMMA 0
. 01067 DELTA 0
. 01070 EPSILON 0
. 01071 FUNCTION 0
. 01072 P 0
. 01073 HALF 2000000000
. 01074 DMINB 0
. 01075 DMIN2CPLB 0
. 01076 EP2BM2UMA 0
. 01077 BESSEL 0
. 01100 0
. 01101 0
. 01102 0
. 01103 0
. 01104 PSQMP 0
. 01105 PSQMP6 0
. 01106 THIRD 1252525252
. 01107 SIXTH 0525252525
. 01110 KENNEDY 0
. 01111 NUMBERIV 0
. 01112 FBESSEL 0
. 01113 0
. 01114 0
. 01115 0
. 01116 0
. 01117 SETINTAD 0
. 01120 INTERPOL ENTRY
. 01121 SUB A*RECSIZE
. 01122 SUB A*RECSIZE
. 01123 ENT B3*A
. 01124 PUT W(B3)*W(FIRSTDIFF)

. 01125 ENT B3*RECSIZE+B3

```

```

UP
01054 00525 25253 1118481120
01055 32666 77130 13750.98708815 43200/PI
01056 10301 24434 .2617993878829 PI/12
01057 21676 43242 .558505361829 PI/720 AT B36
01060 12525 25252 .333333333829 1/24 AT B32
01061 26602 66026 .711111111829 1/1440 AT B39
01062 25060 00000 86400.000812
01063 23040 45527 .595739051829 PI/43200 AT B42
01064 31133 43163 206264.8062811 64800/PI
01065 00000 00000
01066 22150 53170 .568888889829 1/3600 AT B40
01067 31103 75524 6.283185306826 2*PI

01070 00007 46661
01071 00007 46662
01072 00007 46663
01073 00007 46664
01074 00007 46665
01075 00007 46666
01076 00007 46667
01077 00007 46670
01100 00007 46671
01101 40000 00000
01102 00000 00000
01103 00000 00000
01104 00000 00000
01105 00000 00000
01106 00000 00000
01107 00000 00000
01110 00000 00000
01111 20000 00000
01112 00000 00000
01113 00000 00000
01114 00000 00000
01115 00000 00000
01116 00000 00000
01117 00000 00000
01120 00000 00000
01121 00000 00000
01122 00000 00000
01123 00000 00000
01124 12525 25252 .333333333829 1/3
01125 05252 52525 .166666667829 1/6
01126 00000 00000
01127 00000 00000
01130 00000 00000
01131 00000 00000
01132 00000 00000
01133 00000 00000
01134 00000 00000
01135 00000 00000
01136 61000 00000
01137 21000 00010
01140 21000 00010
01141 12370 00000
01142 10033 00000
01143 14030 01102
01144 12303 00010

```

•	01126	PUT	W(B3)*W(BETA)	01145	10033	00000
•	01127	ENT	B3*RECSIZE+B3	01146	14030	01103
•	01130	PUT	W(B3)*W(GAMMA)	01147	12303	00010
•	01131	ENT	B3*RECSIZE+B3	01150	10033	00000
•	01132	PUT	W(B3)*W(DELTA)	01151	14030	01104
•	01133	ENT	B3*RECSIZE+B3	01152	12303	00010
•	01134	PUT	W(B3)*W(EPSILON)	01153	10033	00000
•	01135	ENT	A*W(DELTA)	01154	14030	01105
•	01136	SUB	A*W(BETA)	01155	12303	00010
•	01137	STR	A*W(DMINB)	01156	10033	00000
•	01140	ADD	A*W(DMINB)	01157	14030	01106
•	01141	STR	A*W(BESSEL)	01160	11030	01105
•	01142	ENT	A*W(DELTA)	01161	21030	01103
•	01143	ADD	A*W(BETA)	01162	15030	01112
•	01144	SUB	A*W(GAMMA)	01163	20030	01112
•	01145	SUB	A*W(GAMMA)	01164	15030	01115
•	01146	STR	A*W(DMIN2CPLB)	01165	11030	01105
•	01147	ENT	A*W(EPSILON)	01166	20030	01103
•	01150	SUB	A*W(FIRSTDIFF)	01167	21030	01104
•	01151	SUB	A*W(BESSEL)	01170	21030	01104
•	01152	STR	A*W(EP2BM2DMA)	01171	15030	01113
•	01153	ENT	Q*W(P)	01172	11030	01106
•	01154	MUL	W(GAMMA)	01173	21030	01102
•	01155	LSH	AQ*1	01174	21030	01115
•	01156	STR	A*W(BESSEL+1)	01175	15030	01114
•	01157	STR	A*W(BESSEL)	01176	10030	01110
•	01160	LSH	A*1	01177	22030	01104
•	01161	RSH	AQ*1	01200	07000	00001
•	01162	STR	Q*W(FBESSEL)	01201	15030	01116
•	01163	STR	Q*W(FBESSEL+1)	01202	15030	01115
•	01164	ENT	Q*W(P)	01203	06000	00001
•	01165	MUL	W(P)	01204	03000	00001
•	01166	LSH	AQ*1	01205	14030	01130
•	01167	RJP	ROUND	01206	14030	01131
•	01170	SUB	A*W(P)	01207	10030	01110
•	01171	STR	A*W(PSQMP)	01210	22030	01110
•	01172	RSH	AQ*300	01211	07000	00001
•	01173	MUL	W(DMINB)	01212	65000	01426
•	01174	RSH	AQ*1	01213	21030	01110
•	01175	STR	A*W(BESSEL+2)	01214	15030	01122
•	01176	LSH	A*1	01215	03000	00036
•	01177	RSH	AQ*1	01216	22030	01112
•	01200	STR	Q*W(FBESSEL+2)	01217	03000	00001
•	01201	ENT	A*W(PSQMP)	01220	15030	01117
•	01202	RSH	AQ*300	01221	06000	00001
•	01203	DIV	6	01222	03000	00001
•	01204	JP	CIVIL*GP05	01223	14030	01132
•	01205	ADD	A*3*AP05	01224	11030	01122
•	01206	SUB	Q*1	01225	03000	00036
•	01207	JP	LINCOLN	01226	23000	00006
•	01210	SUB	A*3*ANE6	01227	60200	01233
•	01211	ADD	Q*1	01230	20600	00003
•	01212	STR	Q*W(PSQMP6)	01231	27000	00001
•	01213	ENT	Q*W(P)	01232	61000	01235
•	01214	SUB	Q*W(HALF)	01233	21700	00003
				01234	26000	00001
				01235	14030	01123
				01236	10030	01110
				01237	27030	01111

•	01215	MUL	W(PSQMP6)	01240	22030	01123
•	01216	LSH	AQ*1	01241	07000	00001
•	01217	RJP	ROUND	01242	65000	01426
•	01220	ENT	Q*A	01243	10070	00000
•	01221	MUL	W(DMIN2CPLB)	01244	22030	01113
•	01222	LSH	AQ*1	01245	07000	00001
•	01223	STR	A*W(BESSEL+3)	01246	15030	01120
•	01224	LSH	A*1	01247	06000	00001
•	01225	RSH	AQ*1	01250	03000	00001
•	01226	STR	Q*W(FBESSEL+3)	01251	14030	01133
•	01227	ENT	Q*W(PSQMP6)	01252	10030	01123
•	01230	SUB	Q*W(THIRD)	01253	27030	01124
•	01231	MUL	W(PSQMP)	01254	22030	01122
•	01232	LSH	AQ*1	01255	07000	00001
•	01233	RJP	ROUND	01256	65000	01426
•	01234	ENT	Q*A	01257	10070	00000
•	01235	MUL	W(EP2BM2DMA)	01260	22030	01114
•	01236	RSH	AQ*2	01261	03000	00002
•	01237	STR	A*W(BESSEL+4)	01262	15030	01121
•	01240	LSH	A*1	01263	06000	00001
•	01241	RSH	AQ*1	01264	03000	00001
•	01242	STR	Q*W(FBESSEL+4)	01265	14030	01134
•	01243	ENT	A*W(FBESSEL)	01266	11030	01130
•	01244	SEL	CP*W(FBESSEL+2)	01267	51030	01132
•	01245	JP	FL0TEST1*AP0S	01270	60600	01340
•	01246	ENT	Q*W(BESSEL+2)	01271	10030	01117
•	01247	RPL	Y+Q*W(BESSEL)	01272	34030	01115
•	01250	ENT	A*W(FBESSEL+2)	01273	11030	01132
•	01251	RPL	A+Y*W(FBESSEL)	01274	24030	01130
•	01252	SEL	CP*W(FBESSEL+3)	01275	51030	01133
•	01253	JP	FL0TEST2*AP0S	01276	60600	01362
•	01254	ENT	Q*W(BESSEL+3)	01277	10030	01120
•	01255	RPL	Y+Q*W(BESSEL)	01300	34030	01115
•	01256	ENT	A*W(FBESSEL+3)	01301	11030	01133
•	01257	RPL	A+Y*W(FBESSEL)	01302	24030	01130
•	01260	SEL	CP*W(FBESSEL+4)	01303	51030	01134
•	01261	JP	FL0TEST3*AP0S	01304	60600	01404
•	01262	ENT	Q*W(BESSEL+4)	01305	10030	01121
•	01263	RPL	Y+Q*W(BESSEL)	01306	34030	01115
•	01264	ENT	A*W(FBESSEL+4)	01307	11030	01134
•	01265	RPL	A+Y*W(FBESSEL)	01310	24030	01130
•	01266	ENT	Q*W(P)	01311	10030	01110
•	01267	SUB	Q*W(HALF)	01312	27030	01111
•	01270	MUL	W(DMINB)	01313	22030	01112
•	01271	RJP	ROUND	01314	65000	01426
•	01272	STR	A*W(KENNEDY)	01315	15030	01126
•	01273	ENT	Q*W(PSQMP)	01316	10030	01122
•	01274	ADD	Q*W(SIXTH)	01317	26030	01125
•	01275	MUL	W(DMIN2CPLB)	01320	22030	01113
•	01276	RJP	ROUND	01321	65000	01426
•	01277	ADD	A*W(KENNEDY)	01322	20030	01126
•	01300	ADD	A*W(GAMMA)	01323	20030	01104
•	01301	STR	A*W(NUMDERIV)	01324	15030	01127
•	01302	ENT	A*W(FBESSEL)*ANEG	01325	11730	01130
•	01303	JP	PLUS	01326	61000	01333
•	01304	LSH	A*1*AP0S	01327	06600	00001
•	01305	ENT	A*W(BESSEL)*SKIP	01330	11130	01115
•	01306	RPL	Y-1*W(BESSEL)	01331	37030	01115
•	01307	JP	SUM	01332	61000	01336

• 01310 PLUS	LSH A*1*ANEG	01333 06700 00001	
• 01311	ENT A**W(BESSEL)*SKIP	01334 11130 01115	
• 01312	RPL Y+1*W(BESSEL)	01335 36030 01115	
• 01313 SUM	ADD A**W(0+B4)	01336 20034 00000	
• 01314	EXIT	01337 61010 01136	EXIT FROM INTERPOL
• 01315 FL0TEST1	ENT A**W(FBESSEL)*ANEG	01340 11730 01130	
• 01316	ADD A**W(FBESSEL+2)*SKIP	01341 20130 01132	
• 01317	JP BOTHNEG1	01342 61000 01352	
• 01320	JP NOFL01*AP0S	01343 60600 01271	
• 01321	SEL CL*W(KEY)	01344 52030 01101	
• 01322	STR A**W(FBESSEL)	01345 15030 01130	
• 01323	ENT Q**W(BESSEL+2)	01346 10030 01117	
• 01324	ADD Q*1	01347 26000 00001	
• 01325	RPL Y+Q**W(BESSEL)	01350 34030 01115	
• 01326	JP FIX1+3	01351 61000 01275	
• 01327 BOTHNEG1	ADD A**W(FBESSEL+2)	01352 20030 01132	
• 01330	JP NOFL01*ANEG	01353 60700 01271	
• 01331	SEL SET*W(KEY)	01354 50030 01101	
• 01332	STR A**W(FBESSEL)	01355 15030 01130	
• 01333	ENT Q**W(BESSEL+2)	01356 10030 01117	
• 01334	SUB Q*1	01357 27000 00001	
• 01335	RPL Y+Q**W(BESSEL)	01360 34030 01115	
• 01336	JP FIX1+3	01361 61000 01275	
• 01337 FL0TEST2	ENT A**W(FBESSEL)*ANEG	01362 11730 01130	
• 01340	ADD A**W(FBESSEL+3)*SKIP	01363 20130 01133	
• 01341	JP BOTHNEG2	01364 61000 01374	
• 01342	JP NOFL02*AP0S	01365 60600 01277	
• 01343	SEL CL*W(KEY)	01366 52030 01101	
• 01344	STR A**W(FBESSEL)	01367 15030 01130	
• 01345	ENT Q**W(BESSEL+3)	01370 10030 01120	
• 01346	ADD Q*1	01371 26000 00001	
• 01347	RPL Y+Q**W(BESSEL)	01372 34030 01115	
• 01350	JP FIX2+3	01373 61000 01303	
• 01351 BOTHNEG2	ADD A**W(FBESSEL+3)	01374 20030 01133	
• 01352	JP NOFL02*ANEG	01375 60700 01277	
• 01353	SEL SET*W(KEY)	01376 50030 01101	
• 01354	STR A**W(FBESSEL)	01377 15030 01130	
• 01355	ENT Q**W(BESSEL+3)	01400 10030 01120	
• 01356	SUB Q*1	01401 27000 00001	
• 01357	RPL Y+Q**W(BESSEL)	01402 34030 01115	
• 01360	JP FIX2+3	01403 61000 01303	
• 01361 FL0TEST3	ENT A**W(FBESSEL)*ANEG	01404 11730 01130	
• 01362	ADD A**W(FBESSEL+4)*SKIP	01405 20130 01134	
• 01363	JP BOTHNEG3	01406 61000 01416	
• 01364	JP NOFL03*AP0S	01407 60600 01305	
• 01365	SEL CL*W(KEY)	01410 52030 01101	
• 01366	STR A**W(FBESSEL)	01411 15030 01130	
• 01367	ENT Q**W(BESSEL+4)	01412 10030 01121	
• 01370	ADD Q*1	01413 26000 00001	
• 01371	RPL Y+Q**W(BESSEL)	01414 34030 01115	
• 01372	JP FIX3+3	01415 61000 01311	
• 01373 BOTHNEG3	ADD A**W(FBESSEL+4)	01416 20030 01134	
• 01374	JP NOFL03*ANEG	01417 60700 01305	
• 01375	SEL SET*W(KEY)	01420 50030 01101	
• 01376	STR A**W(FBESSEL)	01421 15030 01130	
• 01377	ENT Q**W(BESSEL+4)	01422 10030 01121	
• 01400	SUB Q*1	01423 27000 00001	
• 01401	RPL Y+Q**W(BESSEL)	01424 34030 01115	
• 01402	JP FIX3+3	01425 61000 01311	

• 01403	COMMENT			
• 01404 ROUND	ENTRY		01426 61000 00000	
• 01405	JP S+4*ANEG		01427 60700 01433	
• 01406	EXIT QPOS		01430 60210 01426	
• 01407	ADD A*1		01431 20000 00001	
• 01410	EXIT		01432 61010 01426	
• 01411	EXIT QNEG		01433 60310 01426	
• 01412	SUB A*1		01434 21000 00001	
• 01413	EXIT		01435 61010 01426	
• 01414	COMMENT			
• 01415 YRREMAIN	0		01436 00000 00000	
• 01416 WHOLEYEAR	0		01437 00000 00000	
• 01417 JULIANDAY	0		01440 00000 00000	
• 01420 IMPERIAL	0		01441 00000 00000	
• 01421 TAPEBLOCK	0		01442 00000 00000	
• 01422 RAAD	0		01443 00000 00000	
• 01423 RADIFAD	0		01444 00000 00000	
• 01424 DECAD	0		01445 00000 00000	
• 01425 DECDIFAD	0		01446 00000 00000	
• 01426 DISTAD	0		01447 00000 00000	
• 01427 DISTDIFAD	0		01450 00000 00000	
• 01430 TIME2	0		01451 00000 00000	
• 01431 SAFE	0		01452 00000 00000	
• 01432 AEPHEM	RESERVE 1151D		01453 00000 00000	
• 01433 LASTEPHEM	0		03652 00000 00000	
• 01434 EPHEMA	U-TAG AEPHEM+191D*AEPHEM		03653 01752 01453	
• 01435 EPHEMB	U-TAG AEPHEM+383D*AEPHEM+192D		03654 02252 01753	
• 01436 EPHEMC	U-TAG AEPHEM+575D*AEPHEM+384D		03655 02552 02253	
• 01437 EPHEMD	U-TAG AEPHEM+767D*AEPHEM+576D		03656 03052 02553	
• 01440 EPHEME	U-TAG AEPHEM+959D*AEPHEM+768D		03657 03352 03053	
• 01441 EPHEMF	U-TAG AEPHEM+1151D*AEPHEM+960D		03660 03652 03353	
• 01442 TAPESEARCH	15 0		03661 00015 00000	15 = TAPE ID FOR MOON
• 01443	COMMENT			
• 01444	COMMENT ...SUBROUTINE 1...			
• 01445	COMMENT			
• 01446	COMMENT CHECK FOR OFFSET			
• 01447	COMMENT IF SO=WHICH INPUT			
• 01450	COMMENT CALCULATE POSITION			
• 01451	COMMENT INITIALLY ONLY			
• 01452 MXINIT	ENTRY		03662 61000 00000	
• 01453	RJP U(INTERCOM)		03663 65020 63426	
• 01454	U-TAG MKMES00*MKMES10		03664 07063 07071	
• 01455	ENT A*W(MOONSW\$)*ANOT		03665 11530 63343	
• 01456	EXIT		03666 61010 03662	NO OFFSET- OUT
• 01457	RJP U(INTERCOM)		03667 65020 63426	
• 01460	U-TAG MKMES01*MKMES11		03670 07073 07111	DETERMINE A,B,C,D CALCULATIONS
• 01461	ENT A*L(MKSWITCH)*AZERO		03671 11410 07115	
• 01462	SUB A*1		03672 21000 00001	
• 01463	STR A*W(MKPOSSW)		03673 15030 06656	MKPOSSW = 0,1,2,3
• 01464	ENT B7*A		03674 12770 00000	
• 01465	RJP L(MXINTAB+B7)		03675 65017 03701	
• 01466	PUT 5*W(MKDELAYCNT)		03676 10000 00005	
			03677 14030 07022	
• 01467	EXIT		03700 61010 03662	EXIT FROM OFFSET INITIALIZATION
• 01470 MXINTAB	0 MXINPOSA		03701 00000 03705	
• 01471	0 MXINPOSB		03702 00000 03761	
• 01472	0 MXINPOSC		03703 00000 04026	

01473	0	MXINPOSD	03704	00000	04073	
01474	COMMENT					
01475	COMMENT	...SUBROUTINE 2...				
01476	COMMENT					
01477	COMMENT	INPUT TYPE A				
01500	COMMENT	SELEN LONG AND LAT				
01501	COMMENT	INPUT = LAT(BETA),LONG(LAMBDA)				
01502	COMMENT	CALCULATE X(S),Y(S),Z(S)				
01503	COMMENT					
01504	MXINPOSA	ENTRY	03705	61000	00000	
01505		RJP U(INTERCOM)	03706	65020	63426	GET BETA
01506		U-TAG MKMES02*MKMESI2	03707	07023	07027	
01507		RJP U(INTERCOM)	03710	65020	63426	GET LAMBDA
01510		U-TAG MKMES03*MKMESI3	03711	07033	07037	
01511		ENT Q*W(MKRADDEG)	03712	10030	06636	RAD/DEG B29
01512		MUL W(MKINBETA)	03713	22030	06662	B20
01513		LSH AQ*8D	03714	07000	00010	A=B49
01514		RJP ROUND	03715	65000	01426	
01515		STR A*W(MKBETA)	03716	15030	06664	B=27
01516		ENT Q*W(MKRADDEG)	03717	10030	06636	B29
01517		MUL W(MKINLAMBDA)	03720	22030	06663	B20
01520		LSH AQ*8D	03721	07000	00010	A=B49
01521		RJP ROUND	03722	65000	01426	
01522		STR A*W(MKLAMBDA)	03723	15030	06665	B=27
01523		ENT A*W(MKBETA)	03724	11030	06664	B27
01524		ENT Q*27D	03725	10000	00033	
01525		RJP SINX	03726	65000	06354	
01526		STR A*W(MKSINB)	03727	15030	06666	SIN(BETA) B28
01527		ENT A*W(MKLAMBDA)	03730	11030	06665	
01530		ENT Q*27D	03731	10000	00033	
01531		RJP SINX	03732	65000	06354	
01532		STR A*W(MKSINL)	03733	15030	06670	B28
01533		ENT A*W(MKBETA)	03734	11030	06664	
01534		ENT Q*27D	03735	10000	00033	
01535		RJP COSX	03736	65000	06343	
01536		STR A*W(MKCOSB)	03737	15030	06667	B28
01537		ENT A*W(MKLAMBDA)	03740	11030	06665	
01540		ENT Q*27D	03741	10000	00033	
01541		RJP COSX	03742	65000	06343	
01542		STR A*W(MKCOSL)	03743	15030	06671	B28
01543		ENT Q*W(MKCOSB)	03744	10030	06667	X(S) = COSB X SINL B28
01544		MUL W(MKSINL)	03745	22030	06670	B28
01545		LSH AQ*2	03746	07000	00002	A=B56
01546		RJP ROUND	03747	65000	01426	
01547		STR A*W(MKXS)	03750	15030	06547	B=28
01550		ENT Q*W(MKSINB)	03751	10030	06666	Y(S) = S IN B
01551		STR Q*W(MKYS)	03752	14030	06550	B28
01552		ENT Q*W(MKCOSB)	03753	10030	06667	Z(S) = COSL X COSB
01553		MUL W(MKCOSL)	03754	22030	06671	X
01554		LSH AQ*2	03755	07000	00002	X
01555		RJP ROUND	03756	65000	01426	X
01556		STR A*W(MKZS)	03757	15030	06551	B28
01557		EXIT	03760	61010	03705	
01560	COMMENT					
01561	COMMENT	...SUBROUTINE 3...				
01562	COMMENT					
01563	COMMENT	INPUT TYPE B				
01564	COMMENT	SELEN DIRECTION COSINES				

• 01565	COMMENT	INPUT = X(S),Y(S)				
• 01566	COMMENT	CALCULATE Z(S)				
• 01567	MXINPOS	ENTRY	03761	61000	00000	METHOD 2 FOR DETERMINING XS, YS, Z
• 01570	COMMENT	GET X(S) AT B28				
• 01571	RJP	U(INTERCOM)	03762	65020	63426	GET INPUT PARAMETERS
• J1572	U-TAG	MKMES04*MKMESI4	03763	07043	07047	
• 01573	ENT	Q*W(MKXS)	03764	10030	06547	B28
• 01574	MUL	W(MKXS)	03765	22030	06547	B28
• 01575	LSH	AQ*2*QP0S	03766	07200	00002	AT B58
• 01576	ADD	A*1	03767	20000	00001	ROUND OFF
• 01577	COM	A*W(MKONE28)*YMORE	03770	04730	06627	
• 01600	ENT	A*W(MKONE28)	03771	11030	06627	1.0 AT B28
• 01601	STR	A*W(MKXS2)	03772	15030	06672	X(S)**2
• 01602	ENT	A*W(MKONE28)	03773	11030	06627	1.0 AT B28
• 01603	SUB	A*W(MKXS2)*AP0S	03774	21630	06672	1-X**2 AT B28
• 01604	CL	A	03775	11000	00000	
• 01605	COM	A*W(MKONE28)*YMORE	03776	04730	06627	
• 01606	ENT	A*W(MKONE28)*SKIP	03777	11130	06627	1.0 AT B28
• 01607	RJP	SQRT	04000	65000	06441	AT B28
• 01610	STR	A*W(YSLIMIT+1)	04001	15030	07062	STORE UPPER LIMIT
• 01611	STR	A*CPW(YSLIMIT)	04002	15070	07061	STORE LOWER LIMIT
• 01612	COMMENT	GET Y(S) AT B28				
• 01613	RJP	U(INTERCOM)	04003	65020	63426	
• J1614	U-TAG	MKMES05*MKMESI5	04004	07053	07057	
• 01615	ENT	Q*W(MKYS)	04005	10030	06550	B28
• 01616	MUL	W(MKYS)	04006	22030	06550	B28
• 01617	LSH	AQ*2*QP0S	04007	07200	00002	AT B58
• 01620	ADD	A*1	04010	20000	00001	ROUND OFF
• 01621	COM	A*W(MKONE28)*YMORE	04011	04730	06627	
• 01622	ENT	A*W(MKONE28)	04012	11030	06627	1.0 AT B28
• 01623	STR	A*W(MKYS2)	04013	15030	06673	Y(S)**2
• 01624	ENT	A*W(MKONE28)	04014	11030	06627	1 (B28)
• 01625	SUB	A*W(MKXS2)	04015	21030	06672	
• 01626	SUB	A*W(MKYS2)*AP0S	04016	21630	06673	1-X**2-Y**2
• 01627	CL	A	04017	11000	00000	
• 01630	STR	A*W(MKZS2)	04020	15030	06674	Z(S) **2 (B28)
• 01631	COM	A*W(MKONE28)*YMORE	04021	04730	06627	
• 01632	ENT	A*W(MKONE28)*SKIP	04022	11130	06627	1.0 AT B28
• 01633	RJP	SQRT	04023	65000	06441	AT B28
• 01634	STR	A*W(MKZS)	04024	15030	06551	Z(S) AT B28
• 01635	EXIT		04025	61010	03761	
• 01636	COMMENT					
• 01637	COMMENT	...SUBROUTINE 4...				
• 01640	COMMENT					
• 01641	COMMENT	INPUT TYPE C				
• 01642	COMMENT	OBSERVER COORDINATES				
• 01643	COMMENT	INPUT = X(0),Y(0)				
• 01644	COMMENT	CALCULATE Z(0)				
• 01645	COMMENT					
• 01646	MXINPOS	ENTRY	04026	61000	00000	
• 01647	COMMENT	GET X(0) AT B28				
• 01650	RJP	U(INTERCOM)	04027	65020	63426	
• 01651	U-TAG	MKMES06*MKMESI6	04030	07116	07122	
• 01652	ENT	Q*W(MKX0)	04031	10030	06544	B28
• 01653	MUL	W(MKX0)	04032	22030	06544	B28
• 01654	LSH	AQ*2*QP0S	04033	07200	00002	AT B58
• 01655	ADD	A*1	04034	20000	00001	ROUND OFF
• 01656	COM	A*W(MKONE28)*YMORE	04035	04730	06627	

01657	ENT	A*(MKONE28)	04036	11030	06627	1.0 AT B28
01660	STR	A*(MKX02)	04037	15030	06675	X(0) *2 (B28)
01661	ENT	A*(MKONE28)	04040	11030	06627	1.0 AT B28
01662	SUB	A*(MKX02)*AP05	04041	21630	06675	1-X**2 AT B28
01663	CL	A	04042	11000	00000	
01664	COM	A*(MKONE28)*YMORE	04043	04730	06627	
01665	ENT	A*(MKONE28)*SKIP	04044	11130	06627	1.0 AT B28
01666	RJP	SQRT	04045	65000	06441	AT B28
01667	STR	A*(YOLIMIT+1)	04046	15030	07135	STORE UPPER LIMIT
01670	STR	A*CP*(YOLIMIT)	04047	15070	07134	STORE LOWER LIMIT
01671	COMMENT	GET Y(0) AT B28				
01672	RJP	U(INTERCOM)	04050	65020	63426	
01673	U-TAG	MKME07*MKMESI7	04051	07126	07132	
01674	ENT	Q*(MKY0)	04052	10030	06545	B28
01675	MUL	W*(MKY0)	04053	22030	06545	
01676	LSH	AQ*2*QPOS	04054	07200	00002	AT B58
01677	ADD	A*1	04055	20000	00001	ROUND OFF
01700	COM	A*(MKONE28)*YMORE	04056	04730	06627	
01701	ENT	A*(MKONE28)	04057	11030	06627	1.0 AT B28
01702	STR	A*(MKY02)	04060	15030	06676	Y(0) **2 (B28)
01703	ENT	A*(MKONE28)	04061	11030	06627	
01704	SUB	A*(MKX02)	04062	21030	06675	
01705	SUB	A*(MKY02)*AP05	04063	21630	06676	1-X**2-Y**2
01706	CL	A	04064	11000	00000	
01707	STR	A*(MKZ02)	04065	15030	06677	Z(0)**2= 1- X(0)**2- Y(0)**2 (B2
01710	COM	A*(MKONE28)*YMORE	04066	04730	06627	
01711	ENT	A*(MKONE28)*SKIP	04067	11130	06627	1.0 AT B28
01712	RJP	SQRT	04070	65000	06441	AT B28
01713	STR	A*(MKZ0)	04071	15030	06546	
01714	EXIT		04072	61010	04026	
01715	COMMENT					
01716	COMMENT	...SUBROUTINE 5...				
01717	COMMENT					
01720	COMMENT	INPUT TYPE D				
01721	COMMENT	INPUT = DELAY,ANGLE				
01722	COMMENT	CALCULATE X(0),Y(0),Z(0)				
01723	COMMENT					
01724	ENTRY		04073	61000	00000	
01725	RJP	U(INTERCOM)	04074	65020	63426	
01726	U-TAG	MKME08*MKMESI8	04075	07136	07143	DELAY
01727	RJP	U(INTERCOM)	04076	65020	63426	
01730	U-TAG	MKME09*MKMESI9	04077	07147	07154	ANGLE
01731	ENT	A*(MKQ90)	04100	11030	06635	B20
01732	ENT	Q*(MKIANG)	04101	10030	06661	
01733	RJP	SSUB	04102	65000	06324	
01734	RJP	SOVERFLOW	04103	65000	06257	
01735	ENT	Q*A	04104	10070	00000	
01736	MUL	W*(MKRADDEG)	04105	22030	06636	B29
01737	LSH	AQ*8D	04106	07000	00010	SCALE B27
01740	RJP	ROUND	04107	65000	01426	
01741	STR	A*(MKDANG)	04110	15030	06700	90 - IN RADIUS B27
01742	ENT	Q*27D	04111	10000	00033	
01743	RJP	SINX	04112	65000	06354	
01744	STR	A*(MKSINDA)	04113	15030	06701	B28 SIN
01745	ENT	A*(MKDANG)	04114	11030	06700	
01746	ENT	Q*27D	04115	10000	00033	
01747	RJP	COSX	04116	65000	06343	
01750	STR	A*(MKCOSDA)	04117	15030	06702	B28 COS

MXINPOSD

• 01751	ENT	Q*W(MKIDELAY)	04120	10030	06660	
• 01752	MUL	W(MKQR11)	04121	22030	06620	1/11.595 B29
• 01753	LSH	AQ*4	04122	07000	00004	A
• 01754	RJP	ROUND	04123	65000	01426	
• 01755	STR	A*W(MKDKK2)	04124	15030	06705	D/11.595 B28
• 01756	ENT	Q*A	04125	10070	00000	DIVIDE BY 2
• 01757	RSH	Q*1	04126	01000	00001	B28 D/2(1/11.595)
• 01760	ENT	A*W(MKONE28)	04127	11030	06627	
• 01761	RJP	SSUB	04130	65000	06324	
• 01762	RJP	SOVERFLOW	04131	65000	06257	
• 01763	ENT	Q*A	04132	10070	00000	1- ABOVE B28
• 01764	MUL	W(MKGALF)	04133	22030	06630	CONSTANT ALPHA B29
• 01765	LSH	AQ*1	04134	07000	00001	SCALE AT 28
• 01766	RJP	ROUND	04135	65000	01426	
• 01767	STR	A*W(MKT1)	04136	15030	07000	K3=ALPH(1-1/2(D/11.595) B28
• 01770	ENT	A*W(MKONE28)	04137	11030	06627	
• 01771	ENT	Q*W(MKDKK2)	04140	10030	06705	
• 01772	RJP	SSUB	04141	65000	06324	
• 01773	RJP	SOVERFLOW	04142	65000	06257	
• 01774	STR	A*W(MKT2)	04143	15030	07001	K4
• 01775	ENT	Q*W(MKT1)	04144	10030	07000	B28
• 01776	RJP	SADD	04145	65000	06305	
• 01777	RJP	SOVERFLOW	04146	65000	06257	
• 02000	STR	A*W(MKZ0)	04147	15030	06546	Z(0) AT B28
• 02001	ENT	Q*A	04150	10070	00000	
• 02002	MUL	W(MKZ0)	04151	22030	06546	
• 02003	LSH	AQ*2*QP05	04152	07200	00002	AT B58
• 02004	ADD	A*1	04153	20000	00001	ROUND OFF
• 02005	COM	A*W(MKONE28)*YMORE	04154	04730	06627	
• 02006	ENT	A*W(MKONE28)	04155	11030	06627	1.0 AT B28
• 02007	STR	A*W(MKZ02)	04156	15030	06677	B28
• 02010	ENT	A*W(MKONE28)	04157	11030	06627	
• 02011	SUB	A*W(MKZ02)*AP05	04160	21630	06677	
• 02012	CL	A	04161	11000	00000	
• 02013	STR	A*W(MKZR02)	04162	15030	06703	1-Z**2 AT B28
• 02014	COM	A*W(MKONE28)*YMORE	04163	04730	06627	
• 02015	ENT	A*W(MKONE28)*SKIP	04164	11130	06627	1.0 AT B28
• 02016	RJP	SQRT	04165	65000	06441	AT B28
• 02017	STR	A*W(MKZR0)	04166	15030	06704	
• 02020	ENT	Q*W(MKZR0)	04167	10030	06704	B28
• 02021	MUL	W(MKCO5DA)	04170	22030	06702	B28
• 02022	LSH	AQ*2	04171	07000	00002	
• 02023	RJP	ROUND	04172	65000	01426	
• 02024	STR	A*W(MKX0)	04173	15030	06544	X(0)
• 02025	ENT	Q*W(MKZR0)	04174	10030	06704	
• 02026	MUL	W(MKSINDA)	04175	22030	06701	
• 02027	LSH	AQ*2	04176	07000	00002	
• 02030	RJP	ROUND	04177	65000	01426	
• 02031	STR	A*W(MKY0)	04200	15030	06545	Y(0)
• 02032	EXIT		04201	61010	04073	
• 02033	COMMENT					
• 02034	COMMENT	...SUBROUTINE 6...				
• 02035	COMMENT					
• 02036	ENTRY		04202	61000	00000	
• 02037	ENT	A*W(SIDERTIME)	04203	11030	63012	LST IN RADIANS B26 (2 SEC OLD)
• 02040	ADD	A*W(DSIDERT)	04204	20030	04217	2 SECONDS IN RAD B26
• 02041	ENT	Q*W(MKRA)	04205	10030	06643	ALF(0) RAD B26

• U2042	RJP	SSUB	04206	65000	06324	
• U2043	RJP	SOVERFLOW	04207	65000	06257	
• U2044	STR	A**W(MKLHA)	04210	15030	06552	LHA= LST-ALF(0) B26 RADIANS
• U2045	ENT	A**W(MKQWE)	04211	11030	06626	B42
• U2046	ENT	Q**W(MKRADOT)	04212	10030	06641	
• U2047	RJP	SSUB	04213	65000	06324	
• U2050	RJP	SOVERFLOW	04214	65000	06257	
• U2051	STR	A**W(MKLHADT)	04215	15030	06553	X D/DT(LHA) B43
• U2052	EXIT		04216	61010	04202	
• U2053 OSIDERT	0000023070		04217	00000	23070	.0001458826 2 SECONDS SIDEREAL TIME, RAD B26
• U2054	COMMENT					
• U2055	COMMENT	...SUBROUTINE 7...				
• U2056	COMMENT					
• U2057 MXRU	ENTKY		04220	61000	00000	
• U2060	ENT	A**W(MKLHA)	04221	11030	06552	
• U2061	ENT	Q*26D	04222	10000	00032	
• U2062	RJP	SINX	04223	65000	06354	
• U2063	STR	A**W(MKSINLHA)	04224	15030	06706	
• U2064	ENT	Q**W(GEUCENLAT)	04225	10030	63322	
• U2065	MUL	W(MKRADEG)	04226	22030	06636	B29
• U2066	LSH	AQ*8D	04227	07000	00010	SCALE AT B27 RADIANS
• U2067	RJP	ROUND	04230	65000	01426	
• U2070	STR	A**W(MKGEO LAT)	04231	15030	06647	B27
• U2071	ENT	Q*27D	04232	10000	00033	
• U2072	RJP	SINX	04233	65000	06354	
• U2073	STR	A**W(MKSINGLAT)	04234	15030	06652	B28 SIN(PHI(C))
• U2074	ENT	A**W(MKLHA)	04235	11030	06552	COS(LHA)
• U2075	ENT	Q*26D	04236	10000	00032	X
• U2076	RJP	COSX	04237	65000	06343	X
• U2077	STR	A**W(MKCOSLHA)	04240	15030	06707	X B28
• U2100	ENT	A**W(MKDEC)	04241	11030	06644	DEC B26
• U2101	ENT	Q*26D	04242	10000	00032	X
• U2102	RJP	SINX	04243	65000	06354	X
• U2103	STR	A**W(MKSINDEC)	04244	15030	06650	X
• U2104	ENT	A**W(MKGEO LAT)	04245	11030	06647	GET COS(GLAT)
• U2105	ENT	Q*27D	04246	10000	00033	
• U2106	RJP	COSX	04247	65000	06343	X
• U2107	STR	A**W(MKCOSGLAT)	04250	15030	06653	X B28
• U2110	ENT	A**W(MKDEC)	04251	11030	06644	COS(DEC)
• U2111	ENT	Q*26D	04252	10000	00032	X
• U2112	RJP	COSX	04253	65000	06343	X
• U2113	STR	A**W(MKCOSDEC)	04254	15030	06651	X B28
• U2114	ENT	A**W(MKGHHO)	04255	11030	06624	B
• U2115	CL	Q	04256	10000	00000	
• U2116	RSH	AQ*4	04257	03000	00004	XXXXX
• U2117	DIV	W(MKDO)*NOOF	04260	23230	06645	D(0) B22
• U2120	RJP	SOVERFLOW	04261	65000	06257	
• U2121	LSH	A*1	04262	06000	00001	X
• U2122	COM	A**W(MKDO)*YMORE	04263	04730	06645	X ROUND
• U2123	ADD	Q*1	04264	26000	00001	
• U2124	STR	Q**W(MK4)	04265	14030	06571	X RHO/D SCALED AT B33
• U2125	MUL	W(MK4)	04266	22030	06571	
• U2126	RJP	ROUND	04267	65000	01426	
• U2127	STR	A**W(MK42)	04270	15030	06777	XXXXX SCALED AT B36
• U2130	COMMENT	INSERT JP MXRNEW HERE FOR OTH ER EQUATION				
• U2131	COMMENT	IF GOING TO NEW CALC DO X DO				

•	02132	ENT	Q*W(MKSINGLAT)	04271	10030	06652	SIN(PHI)X SIN(DEC)
•	02133	MUL	W(MKSINDEC)	04272	22030	06650	X
•	02134	LSH	AQ*2	04273	07000	00002	SCALE AT B28
•	02135	RJP	ROUND	04274	65000	01426	X
•	02136	STR	A*W(MKSINPHID)	04275	15030	06710	
•	02137	ENT	Q*W(MKCOSGLAT)	04276	10030	06653	
•	02140	MUL	W(MKCOSDEC)	04277	22030	06651	B28
•	02141	LSH	AQ*2	04300	07000	00002	X SCALE AT 28
•	02142	RJP	ROUND	04301	65000	01426	
•	02143	ENT	Q*A	04302	10070	00000	
•	02144	MUL	W(MKCOSLHA)	04303	22030	06707	
•	02145	LSH	AQ*2	04304	07000	00002	
•	02146	RJP	ROUND	04305	65000	01426	
•	02147	STR	A*W(MKCOSPHID)	04306	15030	06711	
•	02150	ENT	Q*W(MKSINPHID)	04307	10030	06710	AT B28
•	02151	RJP	SAUD	04310	65000	06305	
•	02152	RJP	SOVERFLOW	04311	65000	06257	
•	02153	STR	A*W(MKCOSZ0)	04312	15030	06712	
•	02154	ENT	Q*W(MKCOSZ0)	04313	10030	06712	B28
•	02155	MUL	W(MK4)	04314	22030	06571	B33
•	02156	RSH	AQ*2	04315	03000	00002	2(RH0/D)COS(Z0) AT B58
•	02157	RJP	ROUND	04316	65000	01426	
•	02160	STR	A*W(MKRH0DC0S)	04317	15030	06713	AT B28
•	02161	ENT	Q*A	04320	10070	00000	
•	02162	ENT	A*W(MK42)	04321	11030	06777	
•	02163	RSH	A*BD	04322	02000	00010	AT B28
•	02164	RJP	SSUB	04323	65000	06324	1 - RH0/D(C0SZ)+RH0**2(B28)
•	02165	RJP	SOVERFLOW	04324	65000	06257	
•	02166	ENT	Q*W(MK0NE28)	04325	10030	06627	
•	02167	RJP	SADD	04326	65000	06305	
•	02170	RJP	SOVERFLOW	04327	65000	06257	
•	02171	STR	A*W(MKRT2)	04330	15030	06714	R**2/D**2 B28
•	02172	RSH	A*2	04331	02000	00002	XXXXX
•	02173	RJP	SGRT	04332	65000	06441	
•	02174	LSH	A*1	04333	06000	00001	
•	02175	STR	A*W(MKRT)	04334	15030	06565	B28
•	02176	ENT	Q*A	04335	10070	00000	
•	02177	MUL	W(MKD0)	04336	22030	06645	B22
•	02200	LSH	AQ*3	04337	07000	00003	B50
•	02201	RJP	ROUND	04340	65000	01426	
•	02202	STR	A*W(MKRO)	04341	15030	06554	R(0) B23
•	02203	NO-OP		04342	12000	00000	
•	02204	ENT	Q*W(MKQCCER)	04343	10030	06615	1/C SEC/E
•	02205	MUL	W(MKRO)	04344	22030	06554	B23
•	02206	LSH	AQ*6	04345	07000	00006	
•	02207	RJP	ROUND	04346	65000	01426	
•	02210	STR	A*W(MKDELAY)	04347	15030	06555	B27
•	02211	EXIT		04350	61010	04220	
•	02212	COMMENT					
•	02213	COMMENT	...SUBROUTINE B...				
•	02214	COMMENT					
•	02215	ENTRY		04351	61000	00000	
•	02216	ENT	Q*W(MKSINLHA)	04352	10030	06706	X
•	02217	MUL	W(MKCOSDEC)	04353	22030	06651	X
•	02220	LSH	AQ*2	04354	07000	00002	A=56 SCALE B28
•	02221	RJP	ROUND	04355	65000	01426	X
•	02222	STR	A*W(MK2)	04356	15030	06567	X B28 K2
•	02223	COMMENT	INSERT JP MXROOTNEW FOR NEW EQ				

02224	ENT	Q*W(MKCOSEDEC)	04357	10030	06651	SIN(PHI)XCOS(DEC)
02225	MUL	W(MKSINGLAT)	04360	22030	06652	X
02226	LSH	AQ*2	04361	07000	00002	X
02227	RJP	ROUND	04362	65000	01426	X
02230	STR	A*W(MKCOSEDPHI)	04363	15030	06716	X SCALED B28
02231	ENT	Q*W(MKCOSEGLAT)	04364	10030	06653	COS(PHI)XS=N(DEC)XCOSLHA
02232	MUL	W(MKSINDEC)	04365	22030	06650	X
02233	LSH	AQ*2	04366	07000	00002	X
02234	RJP	ROUND	04367	65000	01426	X
02235	ENT	Q*A	04370	10070	00000	A TO 6 FOR COSLHA
02236	MUL	W(MKCOSELHA)	04371	22030	06707	X
02237	LSH	AQ*2	04372	07000	00002	X
02240	RJP	ROUND	04373	65000	01426	X
02241	STR	A*W(MKSINOPHI)	04374	15030	06715	X SCALED B28
02242	ENT	A*W(MKCOSEDPHI)	04375	11030	06716	-FACTOR 1 - FACTOR 2)D/DT(DEC)
02243	ENT	Q*W(MKSINOPHI)	04376	10030	06715	X
02244	RJP	SSUB	04377	65000	06324	X
02245	RJP	SOVERFLOW	04400	65000	06257	X
02246	ENT	Q*A	04401	10070	00000	B28-ABOVE D/DR(DEC)
02247	MUL	W(MKDECDOT)	04402	22030	06642	X
02250	LSH	AQ*2	04403	07000	00002	A=R 70-SCALE 42
02251	RJP	ROUND	04404	65000	01426	X
02252	STR	A*W(MKT1)	04405	15030	07000	X T1=B42
02253	ENT	Q*W(MK2)	04406	10030	06567	X
02254	MUL	W(MKCOSEGLAT)	04407	22030	06653	X
02255	LSH	AQ*2	04410	07000	00002	X SCALE B28
02256	RJP	ROUND	04411	65000	01426	X
02257	ENT	Q*A	04412	10070	00000	X
02260	MUL	W(MKLHADT)	04413	22030	06553	X D/DT(LHA) B42 RAD/SEC
02261	LSH	AQ*2	04414	07000	00002	A=70 SCALE AT 42
02262	RJP	ROUND	04415	65000	01426	X
02263	STR	A*W(MKT2)	04416	15030	07001	X T2=B42
02264	ENT	A*W(MKT1)	04417	11030	07000	Z1-Z2=D/DT(COSZ)
02265	ENT	Q*W(MKT2)	04420	10030	07001	X
02266	RJP	SSUB	04421	65000	06324	X
02267	RJP	SOVERFLOW	04422	65000	06257	X
02270	STR	A*W(MKDDTCOSZ)	04423	15030	06717	X D/DT(COSZ) B42
02271	ENT	Q*W(MK4)	04424	10030	06571	B28
02272	MUL	W(MKCOSEZ)	04425	22030	06712	B28
02273	RSH	AQ*3	04426	03000	00003	X SCALE BACK TO B28
02274	RJP	ROUND	04427	65000	01426	X
02275	ENT	Q*A	04430	10070	00000	X 1-ABOVE
02276	ENT	A*W(MKONE28)	04431	11030	06627	X
02277	RJP	SSUB	04432	65000	06324	X
02300	RJP	SOVERFLOW	04433	65000	06257	X
02301	STR	A*W(MKT7)	04434	15030	07004	X
02302	ENT	Q*A	04435	10070	00000	X MULTIPLY BY D/DT(DO)
02303	MUL	W(MKDDOT)	04436	22030	06654	X RADIUS DOT IN N.M. B29
02304	LSH	AQ*2	04437	07000	00002	X
02305	RJP	ROUND	04440	65000	01426	X
02306	STR	A*W(MKT3)	04441	15030	07002	X T3=B29
02307	ENT	Q*W(MKQRO)	04442	10030	06623	2(RHO) N.M. B16
02310	MUL	W(MKDDTCOSZ)	04443	22030	06717	X 2(RHO)D/DT(COSX)B37
02311	RJP	ROUND	04444	65000	01426	X
02312	STR	A*W(MKT4)	04445	15030	07003	X T4=B29
02313	CL	Q	04446	10000	00000	X
02314	ENT	A*W(MKONE28)	04447	11030	06627	1-B28

• 02315	RSH A*2	04450 02000 00002	X MAKE 26 TO AVOID OVERFLOW-CH
• 02316	DIV W(MKRT)*N00F	04451 23230 06565	EC
• 02317	RJP SOVERFLOW	04452 65000 06257	X DIVIDE BY PT B28
• 02320	LSH A*1	04453 06000 00001	X ERROR
• 02321	COM A*W(MKRT)*YMORE	04454 04730 06565	XXXXX
			X ANSWER IN Q-B28 CHECK IF MAY
			BE
• 02322	ADD Q*1	04455 26000 00001	X ROUND
• 02323	STR Q*W(MKT5)	04456 14030 07012	X 712(B28)
• 02324	ENT A*W(MKT3)	04457 11030 07002	Z1
• 02325	ENT Q*W(MKT4)	04460 10030 07003	X
• 02326	RJP SSUB	04461 65000 06324	X
• 02327	RJP SOVERFLOW	04462 65000 06257	X
• 02330	ENT Q*A	04463 10070 00000	X Z1+Z2 IN A B27
• 02331	MUL W(MKT5)	04464 22030 07012	X MUL BY 1/RT B1 B2B
• 02332	LSH AQ*2	04465 07000 00002	X
• 02333	RJP ROUND	04466 65000 01426	X
• 02334	STR A*W(MKRODT)	04467 15030 06556	X D/DT(R0)=R29
• 02335	COMMENT BACK TO HERE FROM NEW EQUATION		
• 02336 MXRODTBACK	N0-0P	04470 12000 00000	
• 02337	EXIT	04471 61010 04351	
• 02340	COMMENT		
• 02341	COMMENT ...SUBROUTINE 9...		
• 02342	COMMENT		
• 02343 MXDUP	ENTRY	04472 61000 00000	
• 02344	ENT Q*W(MKQFC)	04473 10030 06632	2F(C)DR/DT
• 02345	MUL W(MKRODT)	04474 22030 06556	X
• 02346	LSH AQ*1	04475 07000 00001	X
• 02347	RJP ROUND	04476 65000 01426	X
• 02350	STR A*W(MKT1)	04477 15030 07000	X T1=B12
• 02351	ENT Q*W(MKQRCNM)	04500 10030 06640	1/C DR/DT
• 02352	MUL W(MKRODT)	04501 22030 06556	X
• 02353	LSH A*1	04502 06000 00001	X
• 02354	RJP ROUND	04503 65000 01426	X
• 02355	STR A*W(MK20)	04504 15030 06611	X K20=B37
• 02356	ENT Q*W(MK20)	04505 10030 06611	
• 02357	MUL W(MKT1)	04506 22030 07000	X AT R23
• 02360	RSH AQ*7	04507 03000 00007	X
• 02361	RJP ROUND	04510 65000 01426	X
• 02362	STR A*W(MKT3)	04511 15030 07002	X T3=B12
• 02363	ENT Q*W(MKT1)	04512 10030 07000	
• 02364	RJP SSUB	04513 65000 06324	
• 02365	RJP SOVERFLOW	04514 65000 06257	X
• 02366	STR A*W(MKDOPP)	04515 15030 06564	X DOPP=R12
• 02367	EXIT	04516 61010 04472	
• 02370	COMMENT		
• 02371	COMMENT ...SUBROUTINE 10...		
• 02372	COMMENT		
• 02373 MXA	ENTRY	04517 61000 00000	
• 02374	ENT A*W(MK2)	04520 11030 06567	
• 02375	STR A*W(MKCA)	04521 15030 06720	A=R2B
• 02376	ENT Q*W(MKCOSECD)	04522 10030 06651	K1=CO5(DEC)COS(LHA)
• 02377	MUL W(MKCO5LHA)	04523 22030 06707	X R2B
• 02400	LSH AQ*2	04524 07000 00002	X SCALE AT B2B
• 02401	RJP ROUND	04525 65000 01426	X
• 02402	STR A*W(MK1)	04526 15030 06566	X K1=R2B
• 02403	ENT Q*W(MKSINDEC)	04527 10030 06650	T1=SIN(DEC)SIN(LHA)
• 02404	MUL W(MKSINLHA)	04530 22030 06706	X

• U2405	LSH	AQ*2	04531	07000	00002	X SCALE AT 28
• U2406	RJP	ROUND	04532	65000	01426	X
• U2407	STR	A*W(MKT2)	04533	15030	07001	X T2=B28
• U2410	ENT	Q*A	04534	10070	00000	T2(DD/DT)=TJ
• U2411	MUL	W(MKDECDOT)	04535	22030	06642	
• U2412	LSH	AQ*2	04536	07000	00002	
• U2413	RJP	ROUND	04537	65000	01426	X
• U2414	STR	A*W(MKT4)	04540	15030	07003	X T4=B43
• U2415	ENT	Q*W(MK1)	04541	10030	06566	(K1)(D(LHA)/DT)=T3 B28
• U2416	MUL	W(MKLHADT)	04542	22030	06553	X B42
• U2417	LSH	AQ*2	04543	07000	00002	
• U2420	RJP	ROUND	04544	65000	01426	X T3=B42
• U2421	STR	A*W(MKT3)	04545	15030	07002	X
• U2422	ENT	Q*W(MKT4)	04546	10030	07003	T3-T4=D(A)/DT B42
• U2423	RJP	SSUB	04547	65000	06324	X
• U2424	RJP	SOVERFLOW	04550	65000	06257	X
• U2425	STR	A*W(MKCADT)	04551	15030	06721	X D(A)/DT B42 RAD/SEC
• U2426	EXIT		04552	61010	04517	
• U2427	COMMENT					
• U2430	COMMENT	...SUBROUTINE 11...				
• U2431	COMMENT					
• U2432	ENTRY		04553	61000	00000	
• U2433	ENT	Q*W(MK4)	04554	10030	06571	K5=K4COS(GLAT) K4 AT B33
• U2434	MUL	W(MKCOSGLAT)	04555	22030	06653	X B28
• U2435	LSH	AQ*2	04556	07000	00002	X SCALE AT B37
• U2436	RJP	ROUND	04557	65000	01426	X
• U2437	STR	A*W(MK5)	04560	15030	06572	X SCALED AT B33
• U2440	ENT	Q*A	04561	10070	00000	B=K1-K5
• U2441	ENT	A*W(MK1)	04562	11030	06566	X K1=B28
• U2442	RSB	Q*5	04563	01000	00005	X SCALE K5 AT B28
• U2443	RJP	SSUB	04564	65000	06324	X
• U2444	RJP	SOVERFLOW	04565	65000	06257	X
• U2445	STR	A*W(MKCB)	04566	15030	06722	X B=B28
• U2446	ENT	Q*W(MKSINDEC)	04567	10030	06650	XXXXX
• U2447	MUL	W(MKCOSLHA)	04570	22030	06707	XX
• U2450	LSH	AQ*2	04571	07000	00002	X
• U2451	RJP	ROUND	04572	65000	01426	XX
• U2452	STR	A*W(MK3)	04573	15030	06570	XX
• U2453	ENT	Q*W(MK3)	04574	10030	06570	T1=K3D(D)/DT
• U2454	MUL	W(MKDECDOT)	04575	22030	06642	
• U2455	LSH	AQ*2	04576	07000	00002	
• U2456	RJP	ROUND	04577	65000	01426	X
• U2457	STR	A*W(MKT1)	04600	15030	07000	X T1=B45
• U2460	ENT	Q*W(MK2)	04601	10030	06567	
• U2461	MUL	W(MKLHADT)	04602	22030	06553	X K2=B28*D(LHA)/DT=B43
• U2462	LSH	AQ*2	04603	07000	00002	
• U2463	RJP	ROUND	04604	65000	01426	X
• U2464	STR	A*W(MKT2)	04605	15030	07001	X T2=B45
• U2465	ENT	Q*W(MK5)	04606	10030	06572	
• U2466	MUL	W(MKDDOTX)	04607	22030	06655	X K5=B33,DD0/DT IN ER/SEC AT B 40
• U2467	RSB	AQ*9D	04610	03000	00011	
• U2470	DIV	W(MKD0)*N00F	04611	23230	06645	X A0 AT 37,D0 AT 22
• U2471	RJP	SOVERFLOW	04612	65000	06257	X CHECK ROUNDING
• U2472	STR	Q*W(MKT3)	04613	14030	07002	X T3 AT 45
• U2473	ENT	A*W(MKT3)	04614	11030	07002	X
• U2474	ENT	Q*W(MKT2)	04615	10030	07001	T3-T2
• U2475	RJP	SSUB	04616	65000	06324	X
• U2476	RJP	SOVERFLOW	04617	65000	06257	X

02477	ENT	Q*W(MKT1)	04620	10030	07000	X ANSWER-T1
02500	RJP	SSUB	04621	65000	06324	X
02501	RJP	SOVERFLOW	04622	65000	06257	X
02502	STR	A*W(MKCBOT)	04623	15030	06723	X D(B)/DT AT B45 RAD/SEC
02503	EXIT		04624	61010	04553	
02504	COMMENT					
02505	COMMENT	...SUBROUTINE 12...				
02506	COMMENT					
02507	ENTRY		04625	61000	00000	
02510	ENT	Q*W(MK4)	04626	10030	06571	K6=K4SIN(GLAT)
02511	MUL	W(MKSINGLAT)	04627	22030	06652	X K4 AT B33(SIN AT B28
02512	LSH	AQ*2	04630	07000	00002	X
02513	RJP	ROUND	04631	65000	01426	X
02514	STR	A*W(MK6)	04632	15030	06573	X K6 SCALED AT B33
02515	ENT	Q*A	04633	10070	00000	C=SIN(DEC)-K6
02516	RSH	Q*5	04634	01000	00005	
02517	ENT	A*W(MKSINDEC)	04635	11030	06650	X
02520	RJP	SSUB	04636	65000	06324	X
02521	RJP	SOVERFLOW	04637	65000	06257	X
02522	STR	A*W(MKCC)	04640	15030	06724	X C=B28
02523	ENT	Q*W(MKCCOSEC)	04641	10030	06651	T1=COS(DEC)XDD/DT B43
02524	MUL	W(MKDECDOT)	04642	22030	06642	
02525	LSH	AQ*2	04643	07000	00002	
02526	RJP	ROUND	04644	65000	01426	X
02527	STR	A*W(MKT1)	04645	15030	07000	X T1=B45
02530	ENT	Q*W(MK6)	04646	10030	06573	X K6(DD/DT)
02531	MUL	W(MKDDOTX)	04647	22030	06655	
02532	RSH	AQ*9D	04650	03000	00011	
02533	DIV	W(MKDD)*NOOF	04651	23230	06645	X D0=B22
02534	RJP	SOVERFLOW	04652	65000	06257	X
02535	STR	Q*W(MKT2)	04653	14030	07001	X T2=B45
02536	ENT	A*W(MKT1)	04654	11030	07000	X 45
02537	RJP	SADD	04655	65000	06305	X Q + T1
02540	RJP	SOVERFLOW	04656	65000	06257	X
02541	STR	A*W(MKCCDT)	04657	15030	06725	X D(C)/DT RAD/SEC AT B45
02542	EXIT		04660	61010	04625	
02543	COMMENT					
02544	COMMENT	...SUBROUTINE 13...				
02545	COMMENT					
02546	ENTRY		04661	61000	00000	
02547	ENT	Q*W(MKCC)	04662	10030	06724	C AT B28
02550	MUL	W(MKT5)	04663	22030	07012	C*(D0/R0) AT B56
02551	LSH	AQ*2	04664	07000	00002	AT B28
02552	RJP	ROUND	04665	65000	01426	
02553	STR	A*W(MKSINDP)	04666	15030	06726	SIN(DECPRIME) AT B28
02554	ENT	Q*28D	04667	10000	00034	X
02555	RJP	ASINX	04670	65000	06505	X
02556	RSH	A*1	04671	02000	00001	
02557	STR	A*W(MKDP)	04672	15030	06563	X DP-SCALED B27
02560	ENT	Q*26D	04673	10000	00032	
02561	RJP	COSX	04674	65000	06343	X
02562	STR	A*W(MKCCSDP)	04675	15030	06727	X COS(DP)-B28
02563	EXIT		04676	61010	04661	
02564	COMMENT					
02565	COMMENT	...SUBROUTINE 14...				
02566	COMMENT					
02567	ENTRY		04677	61000	00000	
02570	ENT	Q*W(MKRT)	04700	10030	06565	R0/D0 AT B28
02571	MUL	W(MKCCSDP)	04701	22030	06727	X COS=B28, RT=B28

02572	LSH	AQ*2	04702	07000	00002	X	SCALE AT 28
02573	RJP	ROUND	04703	65000	01426	X	
02574	STR	A*W(MKAB)	04704	15030	06732	X	AB=B28
02575	ENT	Q*A	04705	10070	00000		(AB)(AB)
02576	MUL	W(MKAB)	04706	22030	06732	X	
02577	LSH	AQ*2	04707	07000	00002	X	
02600	RJP	ROUND	04710	65000	01426	X	
02601	STR	A*W(MKAB2)	04711	15030	06733	X	B28
02602	ENT	A*W(MKCA)	04712	11030	06720		SIN(LHA-)=A/AB
02603	CL	Q*AP0S	04713	10600	00000		
02604	CP	Q	04714	14000	00000		
02605	RSH	AQ*2	04715	03000	00002	X	SCALE AT 56
02606	DIV	W(MKAB)*N00F	04716	23230	06732	X	A=B28
02607	RJP	SOVERFLOW	04717	65000	06257	X	
02610	COMMENT MAY NEED ROUND OFF HERE						
02611	STR	Q*W(MKSINLHAP)	04720	14030	06730	X	B28
02612	STR	Q*A	04721	14040	00000		LHA=ARCSIN LHA
02613	ENT	Q*28D	04722	10000	00034	X	
02614	RJP	ASINX	04723	65000	06505	X	
02615	RSH	A*1	04724	02000	00001		X LHA IS NOW B2L
02616	ENT	Q*W(MKCB)*QNEG	04725	10330	06722		
02617	JP	S+3	04726	61000	04731		
02620	CP	A	04727	15040	00000		
02621	ADD	A*W(MKQ180)	04730	20030	06637		
02622	STR	A*W(MKLHAP)	04731	15030	06731	X	B27-LHA-
02623	ENT	A*W(SIDERTIME)	04732	11030	63012		ALF=LST-LHA-
02624	ENT	Q*W(MKLHAP)	04733	10030	06731	X	
02625	RJP	SSUB	04734	65000	06324	X	
02626	RJP	SOVERFLOW	04735	65000	06257	X	
02627	STR	A*W(MKALFP)	04736	15030	06561	X	ALF=B27 RADIANS
02630	EXIT		04737	61010	04677		
02631	COMMENT						
02632	COMMENT	...SUBROUTINE 15...					
02633	COMMENT						
02634	MXDECPDT	ENTRY	04740	61000	00000		
02635	ENT	Q*W(MKCADT)	04741	10030	06721		T1=ADA/DT
02636	MUL	W(MKCA)	04742	22030	06720	X	A=B28,DA/DT AT 45
02637	LSH	AQ*2	04743	07000	00002	X	SCALE AT 45
02640	RJP	ROUND	04744	65000	01426	X	
02641	STR	A*W(MKT1)	04745	15030	07000	X	T1=B45
02642	ENT	Q*W(MKCBDT)	04746	10030	06723		T2=B08/DT
02643	MUL	W(MKCB)	04747	22030	06722	X	
02644	LSH	AQ*2	04750	07000	00002	X	SCALE AT B37
02645	RJP	ROUND	04751	65000	01426	X	
02646	STR	A*W(MKT2)	04752	15030	07001	X	T2=B45
02647	ENT	Q*W(MKT1)	04753	10030	07000		T3=T2+T1
02650	RJP	SADD	04754	65000	06305		
02651	RJP	SOVERFLOW	04755	65000	06257	X	
02652	STR	A*W(MKT3)	04756	15030	07002	X	T3=B45
02653	CL	Q*AP0S	04757	10600	00000		
02654	CP	Q	04760	14000	00000		
02655	RSH	AQ*2	04761	03000	00002	X	SCALE AT 73
02656	DIV	W(MKAB)*N00F	04762	23230	06732		D(AB)/DT=T3/AB
02657	RJP	SOVERFLOW	04763	65000	06257	X	T3-B,AB-B28
02660	COMMENT MAY NEED ROUND OFF HERE						
02661	STR	Q*W(MKABDT)	04764	14030	06734	X	D(AB)/DT B45
02662	ENT	Q*W(MKAB)	04765	10030	06732		T4=(AB)DC/DT
02663	MUL	W(MKCCDT)	04766	22030	06725	X	
02664	LSH	AQ*2	04767	07000	00002	X	SCALE AT 45

• 02665	RJP ROUND	04770	65000 01426	X
• 02666	STR A**W(MKT4)	04771	15030 07003	X T4=45
• 02667	ENT Q**W(MKCC)	04772	10030 06724	T5=CDAB/DT
• 02670	MUL W(MKABDT)	04773	22030 06734	X
• 02671	LSH AQ*2	04774	07000 00002	X SCALE AT 45
• 02672	RJP ROUND	04775	65000 01426	X
• 02673	STR A**W(MKT5)	04776	15030 07012	X T5=45
• 02674	ENT Q*A	04777	10070 00000	T6=T4-T5
• 02675	ENT A**W(MKT4)	05000	11030 07003	X
• 02676	RJP SSUB	05001	65000 06324	X
• 02677	RJP SOVERFLOW	05002	65000 06257	X
• 02700	STR A**W(MKT6)	05003	15030 07013	X T6=45
• 02701	CL Q*AP0S	05004	10600 00000	
• 02702	CP Q	05005	14000 00000	
• 02703	RSH AQ*2	05006	03000 00002	X SCALE T6 AT B65
• 02704	DIV W(MKRT2)*N00F	05007	23230 06714	X B28
• 02705	RJP SOVERFLOW	05010	65000 06257	X
• 02706	COMMENT MAY NEED ROUND OFF HERE			
• 02707	STR Q**W(MKDPDT)	05011	14030 06562	X D(DP)/DT AT 45
• 02710	ENT A**W(MKDPDT)	05012	11030 06562	IN RAD/SEC AT B42
• 02711	RSH AQ*5	05013	03000 00005	
• 02712	RJP ROUND	05014	65000 01426	
• 02713	STR A**W(DECD0T)	05015	15030 63010	IN RAD/SEC AT B37
• 02714	EXIT	05016	61010 04740	
• 02715	COMMENT			
• 02716	COMMENT ...SUBROUTINE 16...			
• 02717	COMMENT			
• 02720 MXAPDT	ENTRY	05017	61000 00000	
• 02721	ENT Q**W(MKCB)	05020	10030 06722	T1=BDA/DT
• 02722	MUL W(MKCADT)	05021	22030 06721	X
• 02723	LSH AQ*2	05022	07000 00002	X SCALE AT 45
• 02724	RJP ROUND	05023	65000 01426	X
• 02725	STR A**W(MKT1)	05024	15030 07000	X T1 AT 45
• 02726	ENT Q**W(MKCA)	05025	10030 06720	T2=ADB/DT
• 02727	MUL W(MKCBDT)	05026	22030 06723	X
• 02730	LSH AQ*2	05027	07000 00002	X
• 02731	RJP ROUND	05030	65000 01426	X
• 02732	STR A**W(MKT2)	05031	15030 07001	X T2 AT 42
• 02733	ENT Q*A	05032	10070 00000	X T3=T1-T2
• 02734	ENT A**W(MKT1)	05033	11030 07000	X
• 02735	RJP SSUB	05034	65000 06324	
• 02736	RJP SOVERFLOW	05035	65000 06257	
• 02737	STR A**W(MKT3)	05036	15030 07002	X T3 AT 45
• 02740	CL Q*AP0S	05037	10600 00000	
• 02741	CP Q	05040	14000 00000	
• 02742	RSH AQ*2	05041	03000 00002	X SCALE T3 AT 43
• 02743	DIV W(MKAB2)*N00F	05042	23230 06733	T4=T3/ABZ
• 02744	RJP SOVERFLOW	05043	65000 06257	X AB2=B2B,T3=B37
• 02745	COMMENT MAY NEED ROUND OFF HERE			
• 02746	STR Q**W(MKT4)	05044	14030 07003	X T4 AT 45
• 02747	ENT A**W(MKQWE)	05045	11030 06626	D(A)/DT=W(E)-T4
• 02750	RJP SSUB	05046	65000 06324	X
• 02751	RJP SOVERFLOW	05047	65000 06257	X
• 02752	STR A**W(MKAPDT)	05050	15030 06560	X D(AP)/DT AT 45
• 02753	RSH AQ*5	05051	03000 00005	
• 02754	RJP ROUND	05052	65000 01426	
• 02755	STR A**W(RAD0T)	05053	15030 63007	RAD/SEC AT B37
• 02756	EXIT	05054	61010 05017	
• 02757	COMMENT			

02760	COMMENT	...SUBROUTINE 17...			
02761	COMMENT				
02762	ENTRY		05055	61000	00000
02763	ENT A*W(MKQI)		05056	11030	07164
02764	ENT Q*26D		05057	10000	00032
02765	RJP SINX		05060	65000	06354
02766	STR A*W(MKQISIN)		05061	15030	07166
02767	ENT A*W(MKQI)		05062	11030	07164
02770	ENT Q*26D		05063	10000	00032
02771	RJP COSX		05064	65000	06343
02772	STR A*W(MKQICOS)		05065	15030	07167
02773	ENT A*W(MKALFP)		05066	11030	06561
02774	ENT Q*W(MKQSP)		05067	10030	07165
02775	RJP SSUB		05070	65000	06324
02776	RJP SOVERFLOW		05071	65000	06257
02777	STR A*W(MK7)		05072	15030	06574
03000	ENT Q*26D		05073	10000	00032
03001	RJP COSX		05074	65000	06343
03002	STR A*W(MK8)		05075	15030	06575
03003	ENT Q*A		05076	10070	00000
03004	MUL W(MKCO5DP)		05077	22030	06727
03005	LSH AQ*2		05100	07000	00002
03006	RJP ROUND		05101	65000	01426
03007	STR A*W(MK10)		05102	15030	06577
03010	STR A*CPW(MKCA1)		05103	15070	06760
03011	ENT A*W(MK7)		05104	11030	06574
03012	ENT Q*26D		05105	10000	00032
03013	RJP SINX		05106	65000	06354
03014	STR A*W(MK9)		05107	15030	06576
03015	ENT Q*A		05110	10070	00000
03016	MUL W(MKCO5DP)		05111	22030	06727
03017	LSH AQ*2		05112	07000	00002
03020	RJP ROUND		05113	65000	01426
03021	STR A*W(MK11)		05114	15030	06600
03022	ENT Q*A		05115	10070	00000
03023	MUL W(MKAPDT)		05116	22030	06560
03024	LSH AQ*2		05117	07000	00002
03025	RJP ROUND		05120	65000	01426
03026	STR A*W(MKT1)		05121	15030	07000
03027	ENT Q*W(MK8)		05122	10030	06575
03030	MUL W(MKSINDP)		05123	22030	06726
03031	LSH AQ*2		05124	07000	00002
03032	RJP ROUND		05125	65000	01426
03033	STR A*W(MK12)		05126	15030	06601
03034	ENT Q*A		05127	10070	00000
03035	MUL W(MKDPDT)		05130	22030	06562
03036	LSH AQ*2		05131	07000	00002
03037	RJP ROUND		05132	65000	01426
03040	STR A*W(MKT2)		05133	15030	07001
03041	ENT Q*W(MKT1)		05134	10030	07000
03042	RJP SADD		05135	65000	06305
03043	RJP SOVERFLOW		05136	65000	06257
03044	STR A*W(MKCA1DT)		05137	15030	06735
03045	ENT Q*W(MK9)		05140	10030	06576
03046	MUL W(MKSINDP)		05141	22030	06726
03047	LSH AQ*2		05142	07000	00002
03050	RJP ROUND		05143	65000	01426
03051	STR A*W(MK13)		05144	15030	06602
03052	EXIT		05145	61010	05055

GET SIN(I) AND COS(I)

K7=ALF--S-

X RAD B26

K10=(COS(DP))MK8

X SCALE AT 28

X K10-B28

K9=SIN(K7)

X

X K9=B28

K11=K9COS(DP)

X

X SCALE AT 28

X

X K11-B28

T1=K11D(A-)/DT

X

X

X T1 AT 45

K12=K8SIN(DP)

X

X

X

X K12-B28

T2=K12D(DP)/DT

X

X

X T2 AT 45

D(A1)/DT=T2+T1

X

X

X D(A1)/DT AT 45

K13=K9SIN(DP)

X

X

X

X K13=B28

03053	COMMENT				
03054	COMMENT	...SUBROUTINE 18...			
03055	COMMENT				
03056	ENTRY		05146	61000	00000
03057	ENT Q*W(MKQIC0S)		05147	10030	07167
03060	MUL W(MK11)		05150	22030	06600 X
03061	LSH AQ*2		05151	07000	00002 X SCALE AT 28
03062	RJP ROUND		05152	65000	01426 X
03063	STR A*W(MKT1)		05153	15030	07000 X T1=B28
03064	ENT Q*W(MKSINDP)		05154	10030	06726 T2=SIN(DP)SIN I
03065	MUL W(MKQISIN)		05155	22030	07166 X
03066	LSH AQ*2		05156	07000	00002 X
03067	RJP ROUND		05157	65000	01426 X
03070	STR A*W(MKT2)		05160	15030	07001 X T2=B28
03071	ENT Q*W(MKT1)		05161	10030	07000 B1=-(T1+T2)
03072	RJP SADD		05162	65000	06305 X
03073	RJP SOVERFLOW		05163	65000	06257 X
03074	STR A*CPW(MKCB1)		05164	15070	06736 X B1=B28
03075	ENT Q*W(MKC0SDP)		05165	10030	06727 T3=C0S(DP)SIN I
03076	MUL W(MKQISIN)		05166	22030	07166 X
03077	LSH AQ*2		05167	07000	00002 X
03100	RJP ROUND		05170	65000	01426 X
03101	STR A*W(MKT3)		05171	15030	07002 X T3=B28
03102	ENT Q*W(MKQIC0S)		05172	10030	07167 T4=C0S I(MK13)
03103	MUL W(MK13)		05173	22030	06602 X
03104	LSH AQ*2		05174	07000	00002 X
03105	RJP ROUND		05175	65000	01426 X
03106	STR A*W(MKT4)		05176	15030	07003 X
03107	ENT Q*W(MKT3)		05177	10030	07002 T5=(T4-T3)D(DP/DT)
03110	RJP SSUB		05200	65000	06324 X
03111	RJP SOVERFLOW		05201	65000	06257 X
03112	STR A*W(MKT7)		05202	15030	07004 X
03113	ENT Q*A		05203	10070	00000 X T4-T3 IN A(B28)
03114	MUL W(MKDPDT)		05204	22030	06562 X
03115	LSH AQ*2		05205	07000	00002 X
03116	RJP ROUND		05206	65000	01426 X
03117	STR A*W(MKT5)		05207	15030	07012 X T5 AT 45
03120	ENT Q*W(MK10)		05210	10030	06577 T6=MK10 C0S I D(A-)/DT
03121	MUL W(MKQIC0S)		05211	22030	07167 X B28
03122	LSH AQ*2		05212	07000	00002 X
03123	RJP ROUND		05213	65000	01426 X
03124	STR A*W(MKT8)		05214	15030	07005 X
03125	ENT Q*A		05215	10070	00000 X
03126	MUL W(MKAPDT)		05216	22030	06560 X B45
03127	LSH AQ*2		05217	07000	00002 X
03130	RJP ROUND		05220	65000	01426 X
03131	STR A*W(MKT6)		05221	15030	07013 X T6 AT 45
03132	ENT Q*A		05222	10070	00000 D(B1)/DT=T5-T6
03133	ENT A*W(MKT5)		05223	11030	07012 X
03134	RJP SSUB		05224	65000	06324 X
03135	RJP SOVERFLOW		05225	65000	06257 X
03136	STR A*W(MKCB1DT)		05226	15030	06737 X D(B1)/DT AT 45
03137	EXIT		05227	61010	05146
03140	COMMENT				
03141	COMMENT				
03142	COMMENT	...SUBROUTINE 19...			
03143	COMMENT				
03144	ENTRY		05230	61000	00000
03145	ENT Q*W(MKQIC0S)		05231	10030	07167 K15=SIN(DP)C0S I

03146	MUL	W(MKSINBP)	05232	22030	06726	X
03147	LSH	AQ*2	05233	07000	00002	X
03150	RJP	ROUND	05234	65000	01426	X
03151	STR	A*W(MK15)	05235	15030	06604	X B28
03152	ENT	Q*W(MK11)	05236	10030	06600	K14=K11SIN I
03153	MUL	W(MKQISIN)	05237	22030	07166	X
03154	LSH	AQ*2	05240	07000	00002	X
03155	RJP	ROUND	05241	65000	01426	X
03156	STR	A*W(MK14)	05242	15030	06603	X K14-B28
03157	ENT	Q*W(MK15)	05243	10030	06604	C1=K14-K15
03160	RJP	SSUB	05244	65000	06324	X
03161	RJP	SOVERFLOW	05245	65000	06257	X
03162	STR	A*W(MKCC1)	05246	15030	06740	X B28
03163	ENT	Q*W(MKQISIN)	05247	10030	07166	K17=K10SIN I
03164	MUL	W(MK10)	05250	22030	06577	X
03165	LSH	AQ*2	05251	07000	00002	X
03166	RJP	ROUND	05252	65000	01426	X
03167	STR	A*W(MK17)	05253	15030	06606	X B28
03170	ENT	Q*A	05254	10070	00000	T1=K17D(A-)/DT
03171	MUL	W(MKAPDT)	05255	22030	06560	X
03172	LSH	AQ*2	05256	07000	00002	X
03173	RJP	ROUND	05257	65000	01426	X
03174	STR	A*W(MKT1)	05260	15030	07000	X T1 AT 45
03175	ENT	Q*W(MKCCSDP)	05261	10030	06727	K16=COS(DP)COS I
03176	MUL	W(MKQIC05)	05262	22030	07167	X
03177	LSH	AQ*2	05263	07000	00002	X
03200	RJP	ROUND	05264	65000	01426	X
03201	STR	A*W(MK16)	05265	15030	06605	X K16-B28
03202	ENT	Q*W(MK13)	05266	10030	06602	K18=K13SIN I
03203	MUL	W(MKQISIN)	05267	22030	07166	X
03204	LSH	AQ*2	05270	07000	00002	X
03205	RJP	ROUND	05271	65000	01426	X
03206	STR	A*W(MK18)	05272	15030	06607	X K18-(B28)
03207	ENT	Q*W(MK16)	05273	10030	06605	T2=(K18+K16)D(DP)/DT
03210	RJP	SADD	05274	65000	06305	X
03211	RJP	SOVERFLOW	05275	65000	06257	X
03212	STR	A*W(MKT3)	05276	15030	07002	X
03213	ENT	Q*A	05277	10070	00000	X
03214	MUL	W(MKDPDT)	05300	22030	06562	X
03215	LSH	AQ*2	05301	07000	00002	X
03216	RJP	ROUND	05302	65000	01426	X
03217	STR	A*W(MKT2)	05303	15030	07001	X T2 AT 45
03220	ENT	Q*A	05304	10070	00000	DC1/DT=T2-T1
03221	ENT	A*W(MKT1)	05305	11030	07000	X
03222	RJP	SSUB	05306	65000	06324	X
03223	RJP	SOVERFLOW	05307	65000	06257	X
03224	STR	A*W(MKCC1DT)	05310	15030	06741	X D(C1)/DT AT 45
03225	EXIT		05311	61010	05230	
03226	COMMENT					
03227	COMMENT	...SUBROUTINE 20...				
03230	COMMENT					
03231	MXSINBP	ENTRY	05312	61000	00000	
03232		ENT A*W(MK14)	05313	11030	06603	SIN BP-K14-K15
03233		ENT Q*W(MK15)	05314	10030	06604	X
03234		RJP SSUB	05315	65000	06324	X
03235		RJP SOVERFLOW	05316	65000	06257	X
03236		STR A*W(MKSINBP)	05317	15030	06743	X B28
03237		ENT Q*28D	05320	10000	00034	BP
03240		RJP ASINX	05321	65000	06505	X

03241	STR A*W(MKBP)	05322	15030	06742	X B27 RADIANS
03242	ENT Q*27D	05323	10000	00033	COS BP
03243	RJP COSX	05324	65000	06343	X
03244	STR A*W(MKCOSBP)	05325	15030	06744	X B28
03245	EXIT	05326	61010	05312	
03246	COMMENT				
03247	COMMENT ...SUBROUTINE 21...				
03250	COMMENT				
03251	ENTRY	05327	61000	00000	
03252	ENT A*W(MKCB1)	05330	11030	06736	
03253	CL Q*AP0S	05331	10600	00000	
03254	CP G	05332	14000	00000	
03255	RSH AQ*2	05333	03000	00002	X SCALE A1 AT R56
03256	DIV W(MKCOSBP)*N00F	05334	23230	06744	X
03257	RJP SOVERFLOW	05335	65000	06257	X
03260	COMMENT MAY NEED ROUND OFF HERE				
03261	STR Q*W(MKT1)	05336	14030	07000	X T1=B28
03262	STR Q*A	05337	14040	00000	T2=ARCSIN T1
03263	ENT Q*28D	05340	10000	00034	X
03264	RJP ASINX	05341	65000	06505	X
03265	RSH A*1	05342	02000	00001	
03266	STR A*W(MKT2)	05343	15030	07001	X RADIANS B26
03267	COMMENT CHECK COS OF SUM FOR NEG				
03270	COMMENT IF NEG ...ANG = 180-ANG				
03271	ENT A*W(MKCOSBP)	05344	11030	06744	
03272	ENT Q*W(MKCA1)*AP0S	05345	10630	06760	
03273	JP MKLAG	05346	61000	05356	
03274	JP MKL0K*QP0S	05347	60200	05357	ANG OK ...CONTINUE
03275	ENT A*W(MKQ180)	05350	11030	06637	ANG IN WRONG QUAD...SUBTRACT
03276	ENT Q*W(MKT2)	05351	10030	07001	
03277	RJP SSUB	05352	65000	06324	
03300	RJP SOVERFLOW	05353	65000	06257	
03301	STR A*W(MKT2)	05354	15030	07001	
03302	JP \$+2	05355	61000	05357	
03303	JP MKLCON*QP0S	05356	60200	05350	WRONG QUAD IF Q POS
03304	ENT A*W(MKT2)	05357	11030	07001	
03305	NO-OP	05360	12000	00000	X
03306	ENT Q*W(MKQK1)	05361	10030	07162	LP=T2-QK1
03307	RJP SSUB	05362	65000	06324	X
03310	RJP SOVERFLOW	05363	65000	06257	X
03311	STR A*W(MKLP)	05364	15030	06745	X RAD-B27
03312	ENT Q*26D	05365	10000	00032	
03313	RJP SINX	05366	65000	06354	X
03314	STR A*W(MKSINLP)	05367	15030	06746	X B28
03315	ENT A*W(MKLP)	05370	11030	06745	COS LP
03316	ENT Q*26D	05371	10000	00032	
03317	RJP COSX	05372	65000	06343	X
03320	STR A*W(MKCUSLP)	05373	15030	06747	X B28
03321	EXIT	05374	61010	05327	
03322	COMMENT				
03323	COMMENT ...SUBROUTINE 22...				
03324	COMMENT				
03325	ENTRY	05375	61000	00000	
03326	ENT Q*W(MKQISIN)	05376	10030	07166	SIN CP=(SIN I)K8
03327	MUL W(MK8)	05377	22030	06575	X AQ=B56
03330	DIV W(MKCOSBP)*N00F	05400	23230	06744	X B28
03331	RJP SOVERFLOW	05401	65000	06257	X
03332	COMMENT MAY NEED ROUND OFF HERE				
03333	STR Q*CPW(MKSINCP)	05402	14070	06751	

•	03334	ENT A*W(MKSINCP)	05403	11030	06751	
•	03335	ENT Q*28D	05404	10000	00034	X
•	03336	RJP ASINX	05405	65000	06505	X
•	03337	STR A*W(MKCP)	05406	15030	06750	X B27
•	03340	ENT Q*27D	05407	10000	00033	COS CP
•	03341	RJP CUSX	05410	65000	06343	
•	03342	STR A*W(MKCOSCP)	05411	15030	06752	X B28
•	03343	EXIT	05412	61010	05375	
•	03344	COMMENT				
•	03345	COMMENT ...SUBROUTINE 23...				
•	03346	COMMENT				
•	03347	ENTRY	05413	61000	00000	
•	03350	ENT A*W(MKCC1DT)	05414	11030	06741	D(R-)/DT
•	03351	CL Q*AP0S	05415	10600	00000	
•	03352	CP Q	05416	14000	00000	
•	03353	RSH AQ*2	05417	03000	00002	X COS B-=B28-SCALE AQ AT 65
•	03354	DIV W(MKCOSBP)*N00F	05420	23230	06744	X
•	03355	RJP SOVERFLOW	05421	65000	06257	X
•	03356	COMMENT MAY NEED ROUND OFF HERE				
•	03357	STR Q*W(MKUPDT)	05422	14030	06753	
•	03360	EXIT	05423	61010	05413	
•	03361	COMMENT				
•	03362	COMMENT ...SUBROUTINE 24...				
•	03363	COMMENT				
•	03364	ENTRY	05424	61000	00000	
•	03365	ENT Q*W(MKCB1)	05425	10030	06736	T4=BDA/DT
•	03366	MUL W(MKCA1DT)	05426	22030	06735	X
•	03367	LSH AQ*2	05427	07000	00002	X
•	03370	RJP ROUND	05430	65000	01426	X
•	03371	STR A*W(MKT4)	05431	15030	07003	X T4 AT 45
•	03372	ENT Q*W(MKCA1)	05432	10030	06760	T5=ADB/DT
•	03373	MUL W(MKCB1DT)	05433	22030	06737	X
•	03374	LSH AQ*2	05434	07000	00002	X
•	03375	RJP ROUND	05435	65000	01426	X
•	03376	STR A*W(MKT5)	05436	15030	07012	X T5 AT 45
•	03377	ENT Q*W(MKT4)	05437	10030	07003	T1=T5-T4
•	03400	RJP SSUB	05440	65000	06324	X
•	03401	RJP SOVERFLOW	05441	65000	06257	X
•	03402	STR A*W(MKT1)	05442	15030	07000	X T1 AT 45
•	03403	ENT Q*W(MKCOSBP)	05443	10030	06744	T3=(COSBP)(COSBP)
•	03404	MUL W(MKCOSBP)	05444	22030	06744	X
•	03405	LSH AQ*2	05445	07000	00002	X
•	03406	RJP ROUND	05446	65000	01426	X
•	03407	STR A*W(MKT3)	05447	15030	07002	X T3=B28
•	03410	ENT A*W(MKT1)	05450	11030	07000	T2=T1/T3
•	03411	CL Q*AP0S	05451	10600	00000	
•	03412	CP Q	05452	14000	00000	
•	03413	RSH AQ*2	05453	03000	00002	X SCALE T1 AT 65
•	03414	DIV W(MKT3)*N00F	05454	23230	07002	X
•	03415	RJP SOVERFLOW	05455	65000	06257	X
•	03416	COMMENT MAY NEED ROUND OFF HERE				
•	03417	STR Q*W(MKT2)	05456	14030	07001	X T2 AT 45
•	03420	ENT A*W(MKT2)	05457	11030	07001	
•	03421	ENT Q*W(MKQSDT)	05460	10030	07163	T2-RSDT
•	03422	RJP SSUB	05461	65000	06324	X
•	03423	RJP SOVERFLOW	05462	65000	06257	X
•	03424	STR A*W(MKT4)	05463	15030	07003	X T4 AT 45
•	03425	STR A*W(MKL PDT)	05464	15030	06754	D(LP)/DT AT 45

•	03426	EXIT	05465	61010	05424	
•	03427	COMMENT				
•	03430	COMMENT ...SUBROUTINE 25...				
•	03431	COMMENT				
•	03432	ENTRY	05466	61000	00000	
•	03433	ENT A**W(MKBPDT)	05467	11030	06753	W(X)=D(BP)/DT
•	03434	STR A**W(MKWX)	05470	15030	06755	X 45
•	03435	ENT Q**W(MKCOSBP)	05471	10030	06744	W(Y)=-COS(BP)D(LP)/DT
•	03436	MUL W(MKLPDT)	05472	22030	06754	X
•	03437	LSH AQ*2	05473	07000	00002	X
•	03440	RJP ROUND	05474	65000	01426	X
•	03441	CP A	05475	15040	00000	X
•	03442	STR A**W(MKWX)	05476	15030	06756	X W(Y) AT 45
•	03443	ENT Q**W(MKWX)	05477	10030	06755	T1=(WX)(WX)
•	03444	MUL W(MKWX)	05500	22030	06755	X
•	03445	RJP ROUND	05501	65000	01426	X
•	03446	STR A**W(MKT1)	05502	15030	07000	X T1 AT 60
•	03447	ENT Q**W(MKWX)	05503	10030	06756	T2=(WY)(WY)
•	03450	MUL W(MKWX)	05504	22030	06756	X
•	03451	RJP ROUND	05505	65000	01426	X
•	03452	STR A**W(MKT2)	05506	15030	07001	X T2 AT 60
•	03453	ENT Q**W(MKT1)	05507	10030	07000	T3=T1+T2
•	03454	RJP SADD	05510	65000	06305	X
•	03455	RJP SOVERFLOW	05511	65000	06257	X
•	03456	STR A**W(MKT3)	05512	15030	07002	X T3 AT 60
•	03457	RSH A*2	05513	02000	00002	X SCALE AT B26 FOR SQRT ROUTIN
•	03460	RJP SQRT	05514	65000	06441	E
•	03461	LSH A*2	05515	06000	00002	WA= SQRT(T3)
•	03462	STR A**W(MKWA)	05516	15030	06757	X SCALE AT 4K FOR STORE
•	03463	ENT Q**W(MKWA)	05517	10030	06757	X W(A) AT 45
•	03464	MUL W(MKQBNM)	05520	22030	06633	T2=2FBWA
•	03465	LSH AQ*3	05521	07000	00003	X
•	03466	RJP ROUND	05522	65000	01426	X
•	03467	ENT Q*A	05523	10070	00000	X A=2 B W(A) B45
•	03470	MUL W(MKQFC)	05524	22030	06632	X F=B23
•	03471	LSH AQ*6	05525	07000	00006	X
•	03472	RJP ROUND	05526	65000	01426	
•	03473	STR A**W(MKT2)	05527	15030	07001	X T2=B22 CHECK MAX
•	03474	ENT Q*A	05530	10070	00000	T2(T1)=T3
•	03475	MUL W(MK20)	05531	22030	06611	X
•	03476	RSH AQ*7	05532	03000	00007	X
•	03477	RJP ROUND	05533	65000	01426	X
•	03500	STR A**W(MKT3)	05534	15030	07002	X T3=B22
•	03501	ENT Q*A	05535	10070	00000	FCL=T2-T3
•	03502	ENT A**W(MKT2)	05536	11030	07001	X
•	03503	RJP SSUB	05537	65000	06324	X
•	03504	RJP SOVERFLOW	05540	65000	06257	X
•	03505	STR A**W(MKFCL)	05541	15030	06557	X B22-MAX=177(8)
•	03506	EXIT	05542	61010	05466	
•	03507	COMMENT				
•	03510	COMMENT ...SUBROUTINE 26...				
•	03511	COMMENT				
•	03512	ENTRY	05543	61000	00000	
•	03513	ENT A**W(MKWX)	05544	11030	06755	SIN DA
•	03514	CL Q*AP0S	05545	10600	00000	
•	03515	CP Q	05546	14000	00000	
•	03516	RSH AQ*2	05547	03000	00002	X SCALE AT 65
•	03517	DIV W(MKWA)*N00F	05550	23230	06757	X

03520	RJP	SOVERFLOW	05551	65000	06257	X
03521	COMMENT	MAY NEED ROUND OFF HERE	05552	14030	06762	X
03522	STR	Q*W(MKSINDDA)	05553	11030	06756	COS DA
03523	ENT	A*W(MKWY)	05554	10600	00000	
03524	CL	Q*APDS	05555	14000	00000	
03525	CP	Q	05556	03000	00002	X
03526	RSH	AQ*2	05557	23230	06757	X
03527	DIV	W(MKWA)*N00F	05560	65000	06257	X
03530	RJP	SOVERFLOW				
03531	COMMENT	MAY NEED ROUND OFF HERE	05561	14030	06761	X
03532	STR	Q*W(MKCOSDDA)	05562	61010	05543	
03533	EXIT					
03534	COMMENT					
03535	COMMENT	...SUBROUTINE 27...				
03536	COMMENT					
03537	ENTRY		05563	61000	00000	
03540	ENT	A*W(MKPOSSW)	05564	11030	06656	0 OR 1 IF INPUT SELENOGRAPHIC
03541	SUB	A*2*ANE6	05565	21700	00002	
03542	EXIT		05566	61010	05563	N0-EXIT
03543	COMMENT					
03544	COMMENT	CALCULATE X(0)				
03545	COMMENT					
03546	ENT	Q*W(MKSINLP)	05567	10030	06746	T2-Z(S)SINLP
03547	MUL	W(MKZS)	05570	22030	06551	X R28
03550	LSH	AQ*2	05571	07000	00002	X
03551	RJP	ROUND	05572	65000	01426	X
03552	STR	A*W(MKT2)	05573	15030	07001	X T2=B28
03553	ENT	Q*W(MKCOSLP)	05574	10030	06747	T1=X(S)COSLP
03554	MUL	W(MKXS)	05575	22030	06547	X
03555	LSH	AQ*2	05576	07000	00002	X
03556	RJP	ROUND	05577	65000	01426	X
03557	STR	A*W(MKT1)	05600	15030	07000	X T1=B28
03560	ENT	Q*W(MKT2)	05601	10030	07001	X(0)=T1-T2
03561	RJP	SSUB	05602	65000	06324	X
03562	RJP	SOVERFLOW	05603	65000	06257	X
03563	STR	A*W(MKX0)	05604	15030	06544	X X(N)=B28
03564	COMMENT					
03565	COMMENT	CALCULATE Y(0)				
03566	COMMENT					
03567	ENT	Q*W(MKZS)	05605	10030	06551	T5=Z(S)COSLPSINBP
03570	MUL	W(MKCOSLP)	05606	22030	06747	X
03571	LSH	AQ*2	05607	07000	00002	X
03572	RJP	ROUND	05610	65000	01426	X
03573	STR	A*W(MKT9)	05611	15030	07006	X T9=Z(S)COSLP (B28)
03574	ENT	Q*A	05612	10070	00000	X
03575	MUL	W(MKSINBP)	05613	22030	06743	X
03576	LSH	AQ*2	05614	07000	00002	X
03577	RJP	ROUND	05615	65000	01426	X
03600	STR	A*W(MKT5)	05616	15030	07012	X T5=B28
03601	ENT	Q*W(MKSINLP)	05617	10030	06746	T4=X(S)SINBPSINLP
03602	MUL	W(MKXS)	05620	22030	06547	X
03603	LSH	AQ*2	05621	07000	00002	X
03604	RJP	ROUND	05622	65000	01426	X
03605	STR	A*W(MKT10)	05623	15030	07007	X T10=X(S)SINLP (B28)
03606	ENT	Q*A	05624	10070	00000	X
03607	MUL	W(MKSINBP)	05625	22030	06743	X
03610	LSH	AQ*2	05626	07000	00002	X
03611	RJP	ROUND	05627	65000	01426	X

• 03612	STR A*W(MKT4)	05630	15030	07003	X T4=B28
• 03613	ENT Q*W(MKYS)	05631	10030	06550	T3=Y(S)C0SBP
• 03614	MUL W(MKC0SBP)	05632	22030	06744	X
• 03615	LSH AQ*2	05633	07000	00002	X
• 03616	RJP ROUND	05634	65000	01426	X
• 03617	STR A*W(MKT3)	05635	15030	07002	X T3=B28
• 03620	ENT Q*W(MKT4)	05636	10030	07003	Y(0)=T3-T4-T5
• 03621	RJP SSUB	05637	65000	06324	X
• 03622	RJP SOVERFLOW	05640	65000	06257	X
• 03623	ENT Q*W(MKT5)	05641	10030	07012	X
• 03624	RJP SSUB	05642	65000	06324	X
• 03625	RJP SOVERFLOW	05643	65000	06257	X
• 03626	STR A*W(MKY0)	05644	15030	06545	X Y(0)=B28
• 03627	COMMENT				
• 03630	COMMENT CLACULATE Z(0)				
• 03631	COMMENT				
• 03632	ENT Q*W(MKC0SBP)	05645	10030	06744	T6=X(S)SINLPC0SBP
• 03633	MUL W(MKT10)	05646	22030	07007	X T6=T10C0SBP
• 03634	LSH AQ*2	05647	07000	00002	X
• 03635	RJP ROUND	05650	65000	01426	X
• 03636	STR A*W(MKT6)	05651	15030	07013	X T6=B28
• 03637	ENT Q*W(MKYS)	05652	10030	06550	T7=Y(S)SINBP
• 03640	MUL W(MKSINBP)	05653	22030	06743	X
• 03641	LSH AQ*2	05654	07000	00002	X
• 03642	RJP ROUND	05655	65000	01426	X
• 03643	STR A*W(MKT7)	05656	15030	07004	X T7=B28
• 03644	ENT Q*W(MKC0SBP)	05657	10030	06744	T8=Z(S)C0SLPC0SBP
• 03645	MUL W(MKT9)	05660	22030	07006	X T8=T9C0SBP
• 03646	LSH AQ*2	05661	07000	00002	X
• 03647	RJP ROUND	05662	65000	01426	X
• 03650	STR A*W(MKT8)	05663	15030	07005	X T8=B28
• 03651	ENT Q*W(MKT6)	05664	10030	07013	Z(0)=T6+T7+T8
• 03652	RJP SADD	05665	65000	06305	X
• 03653	RJP SOVERFLOW	05666	65000	06257	X
• 03654	ENT Q*W(MKT7)	05667	10030	07004	X
• 03655	RJP SADD	05670	65000	06305	X
• 03656	RJP SOVERFLOW	05671	65000	06257	X
• 03657	STR A*W(MKZ0)	05672	15030	06546	X Z(0)=B28
• 03660	EXIT	05673	61010	05563	
• 03661	COMMENT				
• 03662	COMMENT ...SUBROUTINE 28...				
• 03663	COMMENT				
• 03664 MXDELALF	ENTRY	05674	61000	00000	
• 03665	ENT A*W(MKQBER)	05675	11030	06634	B IN ER AT B29
• 03666	CL Q*AP0S	05676	10600	00000	
• 03667	CP Q	05677	14000	00000	
• 03670	RSH AQ*1	05700	03000	00001	X
• 03671	DIV W(MKRO)*N00F	05701	23230	06554	X
• 03672	RJP SOVERFLOW	05702	65000	06257	X
• 03673	COMMENT MAY NEED ROUND OFF HERE				
• 03674	STR Q*W(MKS)	05703	14030	06765	X S AT 35
• 03675	ENT A*W(MKS)	05704	11030	06765	T1=S/C0SDP
• 03676	CL Q*AP0S	05705	10600	00000	
• 03677	CP Q	05706	14000	00000	
• 03700	RSH AQ*2	05707	03000	00002	
• 03701	DIV W(MKC0SDP)*N00F	05710	23230	06727	X
• 03702	RJP SOVERFLOW	05711	65000	06257	X
• 03703	COMMENT MAY NEED ROUND OFF HERE				
• 03704	STR Q*W(MKT1)	05712	14030	07000	

03705	ENT	Q*W(MKX0)	05713	10030	06544	T2=X(0)C0SCP
03706	MUL	W(MKC0SCP)	05714	22030	06752	X
03707	LSH	AQ*2	05715	07000	00002	X
03710	RJP	ROUND	05716	65000	01426	X
03711	STR	A*W(MKT2)	05717	15030	07001	X T2=B28
03712	ENT	Q*W(MKY0)	05720	10030	06545	T3=Y(0)SINCP
03713	MUL	W(MKSINCP)	05721	22030	06751	X
03714	LSH	AQ*2	05722	07000	00002	X
03715	RJP	ROUND	05723	65000	01426	X
03716	STR	A*W(MKT3)	05724	15030	07002	X T3=R28
03717	ENT	Q*W(MKT2)	05725	10030	07001	T4=T2+T3
03720	RJP	SSUB	05726	65000	06324	X
03721	RJP	SOVERFLOW	05727	65000	06257	X
03722	STR	A*W(MKT4)	05730	15030	07003	X T4=R28
03723	ENT	Q*W(MKT4)	05731	10030	07003	DELALF=(T4)(T1)
03724	MUL	W(MKT1)	05732	22030	07000	X
03725	LSH	AQ*2	05733	07000	00002	X
03726	RJP	ROUND	05734	65000	01426	X
03727	STR	A*W(MKDELALF)	05735	15030	06764	X DELALF AT B35
03730	ENT	Q*W(MKX0)	05736	10030	06544	T5=X(0) SIN CP
03731	MUL	W(MKSINCP)	05737	22030	06751	X
03732	LSH	AQ*2	05740	07000	00002	X
03733	STR	A*W(MKT5)	05741	15030	07012	X T5=R28
03734	ENT	Q*W(MKY0)	05742	10030	06545	T6=Y(0)C0SCP
03735	MUL	W(MKC0SCP)	05743	22030	06752	X
03736	LSH	AQ*2	05744	07000	00002	X
03737	RJP	ROUND	05745	65000	01426	X
03740	STR	A*W(MKT6)	05746	15030	07013	X T6=B28
03741	ENT	Q*W(MKT5)	05747	10030	07012	T7=T6-T5
03742	RJP	SADD	05750	65000	06305	X
03743	RJP	SOVERFLOW	05751	65000	06257	X
03744	STR	A*W(MKT7)	05752	15030	07004	X T7=R28
03745	ENT	Q*A	05753	10070	00000	DELDEL=(T7)(S)
03746	MUL	W(MKS)	05754	22030	06765	X
03747	LSH	AQ*2	05755	07000	00002	X
03750	RJP	ROUND	05756	65000	01426	X
03751	STR	A*W(MKDELDEL)	05757	15030	06763	X DELDEL AT B35
03752	EXIT		05760	61010	05674	
03753	COMMENT					
03754	COMMENT	...SUBROUTINE 29...				
03755	COMMENT					
03756	MXDP00P	ENTRY	05761	61000	00000	
03757	ENT	Q*W(MKS)	05762	10030	06765	S2=(S)(S)
03760	MUL	W(MKS)	05763	22030	06765	X
03761	RSH	AQ*6	05764	03000	00006	X
03762	RJP	ROUND	05765	65000	01426	X
03763	STR	A*W(MKS2)	05766	15030	06775	X SXS B34
03764	ENT	Q*W(MKS)	05767	10030	06765	T1=Z(0)S
03765	MUL	W(MKZ0)	05770	22030	06546	X
03766	LSH	AQ*2	05771	07000	00002	X
03767	RJP	ROUND	05772	65000	01426	X
03770	STR	A*W(MKT1)	05773	15030	07000	X 2T1 AR 34
03771	ENT	Q*A	05774	10070	00000	RTZ2=1-2T1+S2
03772	ENT	A*W(MKS2)	05775	11030	06775	X B28
03773	RJP	SSUB	05776	65000	06324	X
03774	RJP	SOVERFLOW	05777	65000	06257	X
03775	RSH	AQ*6	06000	03000	00006	X PACK TO 28
03776	STR	A*W(MKT5)	06001	15030	07012	X
03777	COMMENT	FOLLOWING RTX AS BEEN CHANGED				

		TO B28				
•	04000	ENT Q*W(MKONE28)	06002	10030	06627	X
•	04001	RJP SADD	06003	65000	06305	X
•	04002	RJP SOVERFLOW	06004	65000	06257	X
•	04003	STR A*W(MKRTX2)	06005	15030	06771	X B28
•	04004	RSH A*2	06006	02000	00002	SCALE AT B26 FOR SWRT ROUTINE
•	04005	RJP SQRT	06007	65000	06441	X
•	04006	LSH A*1	06010	06000	00001	SCALE AT B28 FOR STORAGE
•	04007	STR A*W(MKRTX)	06011	15030	06772	X RTX B28
•	04010	ENT Q*W(MKRTX)	06012	10030	06772	DP=DELAY(RTX)
•	04011	MUL W(MKDELAY)	06013	22030	06555	X DELAY=B27
•	04012	LSH AQ*2	06014	07000	00002	
•	04013	RJP ROUND	06015	65000	01426	X
•	04014	STR A*W(MKDPX)	06016	15030	06773	X DP B27
•	04015	ENT A*W(MKONE28)	06017	11030	06627	T2=1-T1
•	04016	ENT Q*W(MKT1)	06020	10030	07000	X
•	04017	RSH Q*7	06021	01000	00007	X
•	04020	RJP SSUB	06022	65000	06324	X
•	04021	RJP SOVERFLOW	06023	65000	06257	X
•	04022	STR A*W(MKT2)	06024	15030	07001	X T2=B28
•	04023	ENT A*W(MKDOPP)	06025	11030	06564	T3=DOPP/RTX B12
•	04024	CL Q*AP05	06026	10600	00000	
•	04025	CP Q	06027	14000	00000	
•	04026	RSH AQ*2	06030	03000	00002	
•	04027	DIV W(MKRTX)*N00F	06031	23230	06772	X B28
•	04030	RJP SOVERFLOW	06032	65000	06257	
•	04031	COMMENT MAY NEED ROUND OFF HERE				
•	04032	STR Q*W(MKT3)	06033	14030	07002	X T3=B12
•	04033	MUL W(MKT2)	06034	22030	07001	X
•	04034	LSH AQ*2	06035	07000	00002	X
•	04035	RJP ROUND	06036	65000	01426	X
•	04036	STR A*W(MKDOP1)	06037	15030	06766	X DOP1=B12
•	04037	ENT Q*W(MKY0)	06040	10030	06545	CALCULATE XD
•	04040	MUL W(MKSINDDA)	06041	22030	06762	
•	04041	LSH AQ*2	06042	07000	00002	X
•	04042	RJP ROUND	06043	65000	01426	X
•	04043	STR A*W(MKT7)	06044	15030	07004	X
•	04044	ENT Q*W(MKX0)	06045	10030	06544	X
•	04045	MUL W(MKCSDDA)	06046	22030	06761	
•	04046	LSH AQ*2	06047	07000	00002	X
•	04047	RJP ROUND	06050	65000	01426	X
•	04050	STR A*W(MKT6)	06051	15030	07013	X
•	04051	ENT Q*W(MKT7)	06052	10030	07004	X
•	04052	RJP SSUB	06053	65000	06324	X
•	04053	RJP SOVERFLOW	06054	65000	06257	X
•	04054	STR A*W(MKXD)	06055	15030	06776	X B28
•	04055	ENT A*W(MKFCL)	06056	11030	06557	T4=FCL/RTX
•	04056	CL Q*AP05	06057	10600	00000	
•	04057	CP Q	06060	14000	00000	
•	04060	RSH AQ*12D	06061	03000	00014	
•	04061	DIV W(MKRTX)*N00F	06062	23230	06772	XB28
•	04062	RJP SOVERFLOW	06063	65000	06257	X
•	04063	COMMENT MAY NEED ROUND OFF HERE				
•	04064	STR Q*W(MKT4)	06064	14030	07003	X T4 AT 12
•	04065	MUL W(MKXD)	06065	22030	06776	DOP2=XDC(T4)
•	04066	LSH AQ*2	06066	07000	00002	X
•	04067	RJP ROUND	06067	65000	01426	X
•	04070	STR A*W(MKDOP2)	06070	15030	06767	X DOP2 AT 12

04071	STR	A*Q	06071	15000	00000	DOPPLER=DOP1-DOP2
04072	RSH	A*4	06072	02000	00004	
04073	STR	A*CPW(MOONDOP2\$)	06073	15070	63170	
04074	ENT	A*W(MKDOP1)	06074	11030	06766	X
04075	RJP	SSUB	06075	65000	06324	X
04076	RJP	SOVERFLOW	06076	65000	06257	X
04077	STR	A*W(MKDOPPLER)	06077	15030	06770	X DOPPLER AT 12
04100	ENT	A*W(MKDELALF)	06100	11030	06764	SCALED AT 35
04101	RSH	AQ*9D	06101	03000	00011	SCALE AT 26
04102	RJP	ROUND	06102	65000	01426	
04103	ADD	A*W(MKALFP)	06103	20030	06561	SCALED AT 26
04104	ENT	Q*A	06104	10070	00000	
04105	MUL	W(REVSRADIAN)	06105	22030	01047	
04106	RJP	ROUND	06106	65000	01426	
04107	STR	A*W(RA)	06107	15030	63002	
04110	ENT	A*W(MKDELDEL)	06110	11030	06763	SCALED AT 35
04111	RSH	AQ*9D	06111	03000	00011	SCALE AT 26
04112	RJP	ROUND	06112	65000	01426	
04113	ADD	A*W(MKDP)	06113	20030	06563	
04114	ENT	Q*A	06114	10070	00000	
04115	MUL	W(REVSRADIAN)	06115	22030	01047	
04116	RJP	ROUND	06116	65000	01426	
04117	STR	A*W(DEC)	06117	15030	63003	
04120	ENT	Q*W(MKRTX)	06120	10030	06772	AT B28
04121	MUL	W(MKRO)	06121	22030	06554	AT B23
04122	LSH	AQ*1	06122	07000	00001	AT B52
04123	RJP	ROUND	06123	65000	01426	
04124	STR	A*W(RADIUS)	06124	15030	63006	
04125	ENT	Q*W(MKT2)	06125	10030	07001	AT B28
04126	MUL	W(MKRODT)	06126	22030	06556	
04127	RSH	AQ*5	06127	03000	00005	AT B52
04130	RJP	ROUND	06130	65000	01426	
04131	STR	A*W(MKT8)	06131	15030	07005	AT B52
04132	ENT	Q*W(MKQBNM)	06132	10030	06633	
04133	MUL	W(MKWA)	06133	22030	06757	
04134	RJP	ROUND	06134	65000	01426	
04135	ENT	Q*A	06135	10070	00000	
04136	MUL	W(MKXD)	06136	22030	06776	
04137	RSH	AQ*7	06137	03000	00007	AT B52
04140	RJP	ROUND	06140	65000	01426	
04141	ADD	A*W(MKT8)	06141	20030	07005	
04142	CL	Q*AP05	06142	10600	00000	
04143	CP	Q	06143	14000	00000	
04144	DIV	W(MKRTX)	06144	23030	06772	AT B28
04145	STR	Q*W(RADIUSDOT)	06145	14030	63011	AT B24
04146	ENT	Q*W(MKT2)	06146	10030	07001	B28
04147	MUL	1	06147	22000	00001	
04150	LSH	AQ*28D	06150	07000	00034	
04151	DIV	W(MKRTX)	06151	23030	06772	
04152	STR	Q*W(DOPFACTORS)	06152	14030	63167	B28
04153	EXIT		06153	61010	05761	
04154	COMMENT					
04155	JP	ATAN	06154	61000	06154	
04156	STR	A*W(ATAN+62D)*AP05	06155	15630	06252	
04157	CP	A	06156	15040	00000	SET POSITIVE
04160	STR	Q*W(ATAN+63D)*QP05	06157	14230	06253	
04161	CP	Q	06160	14000	00000	SET POSITIVE
04162	STR	A-Q*W(ATAN+64D)	06161	33030	06254	FLAG BEARS SIGN (\$Y\$-\$X\$)
04163	ENT	Y+Q*A	06162	30070	00000	RESTORE A

04164	COM	Q*A*YLESS	06163	04270	00000	MIN (\$Y\$, \$X\$) TO A
04165	LSH	AQ*30D	06164	07000	00036	INTERCHANGE A,Q
04166	STR	Q*W(ATAN+65D)	06165	14030	06255	DIVISOR Q MAX (\$Y\$, \$Y\$)
04167	RSH	AQ*2	06166	03000	00002	SCALE DIVIDEND AT 28
04170	DIV	W(ATAN+65D)*N00F	06167	23230	06255	DIVISOR AT 0
04171	JP	L(ATAN)	06170	61010	06154	
04172	STR	Q*W(ATAN+65D)	06171	14030	06255	QUOTIENT AT 28
04173	SUB	A*A	06172	21070	00000	CLEAR ACCUMULATOR
04174	LSH	AQ*6*QP0S	06173	07200	00006	ROUND TO NEAREST 16TH
04175	ADD	A*1	06174	20000	00001	
04176	ENT	B7*A	06175	12770	00000	LOAD INDEX REGISTER FOR TABLE
						LO
04177	STR	Q*W(ATAN+66D)	06176	14030	06256	Y-YR AT 34
04200	ENT	Q*A	06177	10070	00000	YR AT 4
04201	MUL	W(ATAN+65D)	06200	22030	06255	Y YR AT 4+28 32
04202	ADD	A*4	06201	20000	00004	4 1 AT 2 + 30 32
04203	RSH	AQ*4	06202	03000	00004	SCALE AT 1 + Y YR AT 28 IN Q
04204	STR	Q*W(ATAN+65D)	06203	14030	06255	
04205	ENT	A*W(ATAN+66D)	06204	11030	06256	Y YR AT 34
04206	RSH	AQ*8D	06205	03000	00010	SCALE DIVIDEND AT 34-2+30
04207	DIV	W(ATAN+65D)	06206	23030	06255	(Y-Y)/(1+Y YR)
04210	STR	Q*W(ATAN+65D)	06207	14030	06255	2 AT 28
04211	MUL	W(ATAN+65D)	06210	22030	06255	Z 2 AT 56
04212	DIV	W(ATAN+43D)	06211	23030	06227	-3 AT 26, 0 AT 56-26 30
04213	MUL	W(ATAN+65D)	06212	22030	06255	-Z 3/3 AT 28
04214	ADD	A*W(ATAN+65D)	06213	20030	06255	Z - Z 3/3 AT 28
04215	ADD	A*W(ATAN+45D+B7)	06214	20037	06231	ADD TABLE ENTRY
04216	ENT	Q*W(ATAN+64D)*QNEG	06215	10330	06254	CHECK SIGN (\$Y\$, \$X\$)
04217	SUB	A*W(ATAN+44D)*SKIP	06216	21130	06230	COMPLEMENT ANGLE
04220	CP	A	06217	15040	00000	SET NEGATIVE
04221	RSH	A*1	06220	02000	00001	RESULT AT 27
04222	ENT	Q*W(ATAN+63D)*QP0S	06221	10230	06253	SUPPLEMENT IF X NEGATIVE
04223	ADD	A*W(ATAN+44D)*SKIP	06222	20130	06230	PI/2 AT 28 PI AT 27
04224	CP	A	06223	15040	00000	SET POSITIVE
04225	ENT	Q*W(ATAN+62D)*QP0S	06224	10230	06252	ACCORD PROPER SIGN
04226	CP	A	06225	15040	00000	
04227	JP	L(ATAN)	06226	61010	06154	EXIT
04230	63774	42363	06227	63774	42363	3.0016901 AT 26
04231	31103	75524	06230	31103	75524	PI/2 AT 28 PI AT 27
04232	0	0	06231	00000	00000	ARCTAN(00/16) AT 25
04233	00777	25336	06232	00777	25336	1
04234	01772	55652	06233	01772	55652	2
04235	02756	27552	06234	02756	27552	3
04236	03726	67277	06235	03726	67277	4
04237	04661	16716	06236	04661	16716	5
04240	05573	03120	06237	05573	03120	6
04241	06462	35661	06240	06462	35661	7
04242	07326	14701	06241	07326	14701	8
04243	10145	37512	06242	10145	37512	9
04244	10740	02726	06243	10740	02726	10
04245	11505	74016	06244	11505	74016	11
04246	12227	43722	06245	12227	43722	12
04247	12725	42304	06246	12725	42304	13
04250	13400	51742	06247	13400	51742	14
04251	14031	64134	06250	14031	64134	15
04252	14441	76652	06251	14441	76652	16
04253	0	0	06252	00000	00000	TEMPORARIES
04254	0	0	06253	00000	00000	

. 04255	0	0	06254	00000	00000	
. 04256	0	0	06255	00000	00000	
. 04257	0	0	06256	00000	00000	
. 04260 SOVERFLOW	ENTRY		06257	61000	00000	
. 04261	ENT Q*L(SOVERFLOW)		06260	10010	06257	
. 04262	SUB Q*1		06261	27000	00001	
. 04263	LSH Q*15D		06262	05000	00017	
. 04264	ENT A*6060606060		06263	11030	07424	
. 04265	ENT B7*4		06264	12700	00004	
. 04266	LSH A*3		06265	06000	00003	
. 04267	LSH AQ*3		06266	07000	00003	
. 04270	BJP B7*5-2		06267	72700	06265	
. 04271	STR A*W(SOVSTR)		06270	15030	06304	
. 04272	RJP U(PRLOG)		06271	65020	63423	
. 04273	6 SOVMSG		06272	00006	06277	
. 04274	1 0		06273	00001	00000	
. 04275	NO-OP		06274	12000	00000	
. 04276	CL A		06275	11000	00000	
. 04277	EXIT		06276	61010	06257	
. 04300 SOVMSG	FD 5*ARITHMETIC OVERFLOW AT		06277	06271	63115	
			06300	22123	11610	
			06301	05243	31227	
			06302	13212	43405	
			06303	06310	50505	
			06304	00000	00000	
. 04301 SOVSTR	0		06305	61000	00000	
. 04302	COMMENT		06306	60700	06314	
. 04303	COMMENT		06307	60300	06320	
. 04304 SADD	ENTRY		06310	32630	06342	
. 04305	JP SADD1*ANEG		06311	61010	06305	ERROR
. 04306	JP SADD2*QNEG		06312	61000	06321	
. 04307	STR A*Q*W(TEMP)*APOS		06313	12710	06257	
. 04310	EXIT		06314	60200	06320	
. 04311	JP SADXT		06315	32730	06342	
. 04312	ENT B7*L(SOVERFLOW)		06316	61010	06305	ERROR
. 04313 SADD1	JP SADD2*QPOS		06317	61000	06321	
. 04314	STR A*Q*W(TEMP)*ANEG		06320	32030	06342	
. 04315	EXIT		06321	36010	06305	
. 04316	JP SADXT		06322	11030	06342	
. 04317 SADD2	STR A*Q*W(TEMP)		06323	61010	06305	NORMAL
. 04320 SADXT	RPL Y+1*L(SADD)					
. 04321	ENT A*W(TEMP)					
. 04322	EXIT					
. 04323	COMMENT					
. 04324	COMMENT					
. 04325 SSUB	ENTRY		06324	61000	00000	
. 04326	JP SSUB1*ANEG		06325	60700	06332	
. 04327	JP SSUB2*QPOS		06326	60200	06336	
. 04330	STR A-Q*W(TEMP)*APOS		06327	33630	06342	
. 04331	EXIT		06330	61010	06324	ERROR
. 04332	JP SSBXT		06331	61000	06337	
. 04333 SSUB1	JP SSUB2*QNEG		06332	60300	06336	
. 04334	STR A-Q*W(TEMP)*ANEG		06333	33730	06342	
. 04335	EXIT		06334	61010	06324	ERROR
. 04336	JP SSBXT		06335	61000	06337	
. 04337 SSUB2	STR A-Q*W(TEMP)		06336	33030	06342	
. 04340 SSBXT	RPL Y+1*L(SSUB)		06337	36010	06324	
. 04341	ENT A*W(TEMP)		06340	11030	06342	
. 04342	EXIT		06341	61010	06324	NORMAL
. 04343 TEMP	0 0		06342	00000	00000	

04344	COMMENT			
04345	COMMENT			
04346 COS	ENTRY	06343	61000	00000
04347	ENT B7*L(COS)	06344	12710	06343
04350	STR B7*L(SIN)	06345	16710	06354
04351	ENT B7*1	06346	12700	00001
04352	STR B7*L(COS+32)	06347	16710	06375
04353	JP \$+2*AP0S	06350	60600	06352
04354	CP A*AZERO	06351	15440	00000
04355	JP \$+4*AN0T	06352	60500	06356
04356	ENT A*W(COS+66)	06353	11030	06431
04357 SIN	ENTRY	06354	61000	00000
04360	CL L(\$+20)	06355	16010	06375
04361	STR A*W(COS+74)*AP0S	06356	15630	06437
04362	CP A	06357	15040	00000
04363	RPT 29D	06360	70000	00035
04364	LSH A*1*ANEG	06361	06700	00001
04365	EXIT	06362	61010	06354
04366	LSH A*29D	06363	06000	00035
04367	SUB Q*B7*QP0S	06364	27607	00000
04370	JP COS+61	06365	61000	06424
04371	COM Q*31D*YMORE	06366	04300	00037
04372	ENT Q*30D	06367	10000	00036
04373	STR Q*L(\$+1)	06370	14010	06371
04374	ENT B7*0	06371	12700	00000
04375	ENT Q*W(COS+65)	06372	10030	06430
04376	MUL A	06373	22070	00000
04377	RSH AQ*27D+B7	06374	03007	00033
04400	ADD A*0	06375	20000	00000
04401	SEL CL*X77774	06376	52040	77774
04402	ENT B7*A	06377	12770	00000
04403	RSH AQ*1	06400	03000	00001
04404	JP \$+1+B7	06401	61007	06402
04405	JP \$+3	06402	61000	06405
04406	CP Q*SKIP	06403	14100	00000
04407	CP Q	06404	14000	00000
04410	ENT A*W(COS+74)*AP0S	06405	11630	06437
04411	CP Q	06406	14000	00000
04412	STR Q*W(COS+74)	06407	14030	06437
04413	MUL W(COS+74)	06410	22030	06437
04414	LSH AQ*1	06411	07000	00001
04415	STR A*W(COS+75)	06412	15030	06440
04416	ENT B7*3	06413	12700	00003
04417	ENT Q*W(COS+73)	06414	10030	06436
04420	MUL W(COS+75)	06415	22030	06440
04421	ENT Q*A	06416	10070	00000
04422	ADD Q*W(COS+67+B7)	06417	26037	06432
04423	BJP B7*\$-3	06420	72700	06415
04424	MUL W(COS+74)	06421	22030	06437
04425	LSH AQ*1	06422	07000	00001
04426	EXIT	06423	61010	06354
04427	COM Q*X77745*YMORE	06424	04340	77745
04430	JP COS+25	06425	61000	06370
04431	CL A	06426	11000	00000
04432	EXIT	06427	61010	06354
04433	2427630155	06430	24276	30155
04434	2000000000	06431	20000	00000
04435	3110375522	06432	31103	75522
04436	5325041750	06433	53250	41750

04437	0506321276	06434	05063	21276	
04440	7731554634	06435	77315	54634	
04441	0002366574	06436	00023	66574	
04442	0	06437	00000	00000	
04443	0	06440	00000	00000	
04444 COSX	EQUALS COS				
04445 SINX	EQUALS SIN				
04446	COMMENT				
04447	COMMENT				
04450 SQRT	ENTRY	06441	61000	00000	
04451	CL Q	06442	10000	00000	CLEAR Q
04452	RPT 14D	06443	70000	00016	NORMALIZE
04453	RSH AQ*2*AZERO	06444	03400	00002	SHIFT UNTIL A 0
04454	RJP S0VERFLOW*ANOT	06445	64500	06257	
04455	LSH AQ*28D	06446	07000	00034	NORMALIZE IN A
04456	STR A*W(SQRT+34D)*ANOT	06447	15530	06503	STORE NORMALIZED RADICAND
04457	JP SQRT+29D	06450	61000	06476	RADICAND 0
04460	RSH A*3	06451	02000	00003	DIVIDE BY 8 FOR LINEAR APPROX
04461	COM A*W(SQRT+31D)*YMORE	06452	04730	06500	SKIP IF RIT 24 0
04462	ADD A*W(SQRT+33D)*SKIP	06453	20130	06502	ADD 7/8
04463	15140 00000	06454	15140	00000	CP,A,SKIP
04464	ADD A*W(SQRT+34D)*SKIP	06455	20130	06503	ARG/8+7/8+ARG
04465	ADD A*W(SQRT+32D)*SKIP	06456	20130	06501	ADD 9/32
04466	RSH A*1*SKIP	06457	02100	00001	DIVIDE BY 2
04467	ADD A*W(SQRT+34D)	06460	20030	06503	ARG/8+9/32+ARG
04470	STR A*W(SQRT+35D)	06461	15030	06504	LINEAR APPROX COMPLETE
04471	ENT A*W(SQRT+34D)	06462	11030	06503	ENTER RADICAND (SCALED AT 28)
04472	RSH AQ*2	06463	03000	00002	SCALE AT 26
04473	DIV W(SQRT+35D)	06464	23030	06504	DIVIDE (SCALED AT 28)
04474	ADD Q*W(SQRT+35D)	06465	26030	06504	
04475	RSH Q*1	06466	01000	00001	
04476	STR Q*W(SQRT+35D)	06467	14030	06504	
04477	ENT A*W(SQRT+34D)	06470	11030	06503	ENTER RADICAND
04500	RSH AQ*2	06471	03000	00002	SCALE 2(ARG) AT 26
04501	DIV W(SQRT+35D)	06472	23030	06504	DIVIDE RESULT IN Q
04502	ENT Y+Q*W(SQRT+35D)	06473	30030	06504	2(RESULT TO A
04503	RSH AQ*1+B7*QP05	06474	03207	00001	
04504	ADD A*1	06475	20000	00001	ROUND
04505	NO-OP	06476	12000	00000	
04506	EXIT	06477	61010	06441	
04507	01000 00000	06500	01000	00000	
04510	04400 00000	06501	04400	00000	9/32 AT 28
04511	16000 00000	06502	16000	00000	7/8 AT 28
04512	0 0	06503	00000	00000	TEMPORARY
04513	0 0	06504	00000	00000	TEMPORARYATAN
04514	COMMENT				
04515 ASIN	ENTRY	06505	61000	00000	
04516	STR A*W(ASIN+27D)*APOS	06506	15630	06540	
04517	CP A	06507	15040	00000	SET ARGUMENT POSITIVE
04520	COM Q*57D*YMORE	06510	04300	00071	
04521	ENT Q*57D	06511	10000	00071	
04522	ADD Q*2	06512	26000	00002	
04523	JP ASIN+22D*AZERO	06513	60400	06533	
04524	STR Q*L(ASIN+9D)*QP05	06514	14210	06516	
04525	RJP S0VERFLOW	06515	65000	06257	
04526	RSH AQ*0*ANOT	06516	03500	00000	CHECK FOR ARGUMENT GREATER OR

• 04527	STR	Q*W(ASIN+28D)*QP05	06517	14230	06541	
• 04530	RJP	SOVERFLOW	06520	65000	06257	
• 04531	MUL	W(ASIN+28D)	06521	22030	06541	
• 04532	RSH	AQ*28D	06522	03000	00034	
• 04533	SUB	Q*0*QN0T	06523	27500	00000	
• 04534	JP	\$+16	06524	61000	06542	
• 04535	ENT	Y-Q*W(ASIN+26D)	06525	31030	06537	
• 04536	RJP	SQRT	06526	65000	06441	COMPUTE SQRT(1-ARG SQUARED)
• 04537			06527	12000	00000	
• 04540	ENT	Q*A	06530	10070	00000	ARCSINEX ARCTAN(X/SQRT(1-XSQUA RE
• 04541	ENT	A*W(ASIN+28D)	06531	11030	06541	
• 04542	RJP	ATAN	06532	65000	06154	COMPUTE ARCSINE (-X)
• 04543	ENT	Q*W(ASIN+27D)*QP05	06533	10230	06540	
• 04544	CP	A	06534	15040	00000	
• 04545	NO-OP		06535	12000	00000	
• 04546	EXIT		06536	61010	06505	
• 04547		20000 00000	06537	20000	00000	1 AT 28
• 04550		0 0	06540	00000	00000	TEMPORARY
• 04551		0 0	06541	00000	00000	TEMPORARY
• 04552	ENT	A*W(ASIN+26D)	06542	11030	06537	
• 04553	JP	\$-13	06543	61000	06530	
• 04554 ASINX	EQUALS	ASIN				
• 04555	COMMENT					
• 04556	COMMENT	RESULTANT VALUES				
• 04557	COMMENT					
• 04560 MKX0		0 0	06544	00000	00000	B28
• 04561 MKY0		0 0	06545	00000	00000	B28
• 04562 MKZ0		0 0	06546	00000	00000	B28
• 04563 MKXS		0 0	06547	00000	00000	
• 04564 MKYS		0 0	06550	00000	00000	
• 04565 MKZS		0 0	06551	00000	00000	
• 04566 MKLHA		0 0	06552	00000	00000	LHA-B26
• 04567 MKLHADT		0 0	06553	00000	00000	D/DT(LHA)-B37
• 04570 MKR0		0 0	06554	00000	00000	E.R. AT B23
• 04571 MKDELAY		0 0	06555	00000	00000	B27 SECONDS
• 04572 MKRODT		0 0	06556	00000	00000	B27 NM/SEC
• 04573 MKFCL		0 0	06557	00000	00000	CYC/SEC B22
• 04574 MKAPDT		0 0	06560	00000	00000	D(ALF-)/DT-RAD/SEC-B37
• 04575 MKALFP		0 0	06561	00000	00000	ALF- B27 RAD
• 04576 MKDPDT		0 0	06562	00000	00000	D(DEC-)/DT RAD/SEC P37
• 04577 MKDP		0 0	06563	00000	00000	DEC- RADIANS B27
• 04600 MKDOPP		0 0	06564	00000	00000	DOPPLER IN CYCLES AT B12
• 04601	COMMENT					
• 04602	COMMENT	CONSTANTS AT RUN TIME				
• 04603	COMMENT					
• 04604 MKRT		0 0	06565	00000	00000	R(0)/D(0) (B28)
• 04605 MK1		0 0	06566	00000	00000	B28
• 04606 MK2		0 0	06567	00000	00000	B28
• 04607 MK3		0 0	06570	00000	00000	B28
• 04610 MK4		0 0	06571	00000	00000	RHO/D SCALED AT B33
• 04611 MK5		0 0	06572	00000	00000	
• 04612 MK6		0 0	06573	00000	00000	
• 04613 MK7		0 0	06574	00000	00000	RAD-B27
• 04614 MK8		0 0	06575	00000	00000	B28
• 04615 MK9		0 0	06576	00000	00000	B28
• 04616 MK10		0 0	06577	00000	00000	B28
• 04617 MK11		0 0	06600	00000	00000	B28

•	U4620 MK12	0	0	06601	00000	00000	B28
•	U4621 MK13	0	0	06602	00000	00000	B28
•	U4622 MK14	0	0	06603	00000	00000	B28
•	U4623 MK15	0	0	06604	00000	00000	B28
•	U4624 MK16	0	0	06605	00000	00000	B28
•	U4625 MK17	0	0	06606	00000	00000	B28
•	U4626 MK18	0	0	06607	00000	00000	B28
•	U4627 MK19	0	0	06610	00000	00000	
•	U4630 MK20	0	0	06611	00000	00000	
•	U4631	COMMENT					
•	U4632	COMMENT					
•	U4633	COMMENT					
•	U4634	COMMENT	CONSTANTS AT ASSEMBLY TIME				
•	U4635	COMMENT					
•	U4636 MKRK1	0	0	06612	00000	00000	
•	U4637 MKRK2	0	0	06613	00000	00000	
•	U4640 MKRK3	0	0	06614	00000	00000	
•	U4641 MKQCCER	0053445040		06615	00534	45040	.02127558B29 1.0/C IN SEC/E.R.
•	U4642 MKQNMPEK	33420	64260	06616	33420	64260	N.M./E.R. 3.4416059224(B27)
•	U4643 MKQ11	2714121727		06617	27141	21727	11.595825
•	U4644 MKQR11	0260501354		06620	02605	01354	.0862440707B29 1/11.595
•	U4645 MKHLF	20000	00000	06621	20000	00000	1/2 B29
•	U4646 TENB25	2400000000		06622	24000	00000	10825
•	U4647 MKGR0	3267301310		06623	32673	01310	3438.755435B17 GE0CEN RADIUS I
•	U4650 MKQRH0	3774706124		06624	37747	06124	N N.M. .99848B29 GE0CEN RADIUS IN E.R.
•	U4651 MKQRH0X	15534	37154	06625	15534	37154	EXTENSION OF ABOVE
•	U4652 MKQWE	23073	23776	06626	23073	23776	W(E) B42
•	U4653 MKONE28	2000000000		06627	20000	00000	1.0028
•	U4654 MKQALF	0011205012		06630	00112	05012	.00452139B29 ALPHA
•	U4655 MKQERPNI	23016	71142	06631	23016	71142	E.R./N.M. B37
•	U4656 MKGFC	2751405503		06632	27514	05503	48432.352B13 7840 MHZ IN 1/NM
•	U4657 MKQBNM	3524707461		06633	35247	07461	938.4449184B19 LUNAR RADIUS IN
•	U4660 MKQBER	1056034021		06634	10560	34021	N.M. .2724876721B29 LUNAR RADIUS IN
•	U4661 MKQ90	0550000000		06635	05500	00000	E.R. 90.0820 90 DEGREES AT B20
•	U4662 MKRADDEG	0043575065		06636	00435	75065	.0174532925B29 DEG/RAD
•	U4663 MKQ180	1444176652		06637	14441	76652	3.141592654B26 PI
•	U4664 MKGRCNM	00031	72222	06640	00031	72222	I/C B37 SEC/N.M
•	U4665	COMMENT					
•	U4666	COMMENT	COMMON STORAGE EQUIVALENTS				
•	U4667	COMMENT					
•	U4670 MKRADOT	0		06641	00000	00000	RAD/SEC AT B42
•	U4671 MKDECDOT	0		06642	00000	00000	RAD/SEC AT B42
•	U4672 MKRA	0	0	06643	00000	00000	ALPHA B26 RADIAN
•	U4673 MKDEC	0	0	06644	00000	00000	DEC B26 RADIAN
•	U4674 MKD0	0		06645	00000	00000	RADIUS IN E.R. AT B22
•	U4675 MKD02	0	0	06646	00000	00000	B22 D(0)**2
•	U4676 MKGEOLAT	0	0	06647	00000	00000	GE0CENTRIC LAT OF SITE - RADIA
•	U4677 MKSINDEC	0	0	06650	00000	00000	NS B28 SIN(DEC)
•	U4700 MKCOSDEC	0	0	06651	00000	00000	SIN(DEC) B28
•	U4701 MKSINGLAT	0	0	06652	00000	00000	SIN(PHI)B28
•	U4702 MKCOSGLAT	0	0	06653	00000	00000	COS(PHI) B28
•	U4703 MKDDOT	0		06654	00000	00000	N.M./SEC AT B29
•	U4704 MKDDOTA	0		06655	00000	00000	E.R./SEC AT B40

.	04705	COMMENT				
.	04706	COMMENT	INPUT PARAMETERS			
.	04707	COMMENT				
.	04710	MKPOSSW	0	0	06656	00000 00000
.	04711	MKOFFSW	0	0	06657	00000 00000 0= NO OFFSET *L = OFFSET
.	04712	MKIDELAY	0	0	06660	00000 00000 B25
.	04713	MKIANG	0	0	06661	00000 00000
.	04714	MKINBETA	0	0	06662	00000 00000 B20
.	04715	MKINLAMBDA	0	0	06663	00000 00000 B20
.	04716	COMMENT				
.	04717	COMMENT	CONSTANTS FROM ROUTINES 2 TO 5			
.	04720	COMMENT				
.	04721	MKBETA	0	0	06664	00000 00000 B27
.	04722	MKLAMBDA	0	0	06665	00000 00000 B27
.	04723	MKSINB	0	0	06666	00000 00000 B28
.	04724	MKCSOB	0	0	06667	00000 00000 B28
.	04725	MKSINL	0	0	06670	00000 00000 B28
.	04726	MKCSOL	0	0	06671	00000 00000 B28
.	04727	MKXS2	0	0	06672	00000 00000 B28
.	04730	MKYS2	0	0	06673	00000 00000 B28
.	04731	MKZS2	0	0	06674	00000 00000 B28
.	04732	MKX02	0	0	06675	00000 00000 B28
.	04733	MKY02	0	0	06676	00000 00000 B28
.	04734	MKZ02	0	0	06677	00000 00000 B28
.	04735	MKDANG	0	0	06700	00000 00000 90 - INPUT IN RADIAN B27
.	04736	MKSINDA	0	0	06701	00000 00000 B28
.	04737	MKCSODA	0	0	06702	00000 00000 B28
.	04740	MKZRO2	0	0	06703	00000 00000 B28 1-Z(0)**2=R(0)**2
.	04741	MKZRO	0	0	06704	00000 00000 B28
.	04742	COMMENT				
.	04743	COMMENT				
.	04744	MKDKK2	0	0	06705	00000 00000
.	04745	MKSINLHA	0	0	06706	00000 00000
.	04746	MKCSOLHA	0	0	06707	00000 00000 COS(LHA)
.	04747	MKSINPHID	0	0	06710	00000 00000 SIN(PHI)X SIN(DEC)
.	04750	MKCSOPHID	0	0	06711	00000 00000 COS(PHI)X COS(DEC)X COS(LHA)
.	04751	MKCSOZ0	0	0	06712	00000 00000 COS Z0 PG.3 B28
.	04752	MKRHODCOS	0	0	06713	00000 00000 COSZ(RH0/D) B29
.	04753	MKRT2	0	0	06714	00000 00000 B28
.	04754	MKSINDPHI	0	0	06715	00000 00000 B28
.	04755	MKCSODPHI	0	0	06716	00000 00000 B28
.	04756	MKDDTCOSZ	0	0	06717	00000 00000 B37
.	04757	MKCA	0	0	06720	00000 00000 A- B28
.	04760	MKCAOT	0	0	06721	00000 00000 DA/DT B37
.	04761	MKCB	0	0	06722	00000 00000 B28-B
.	04762	MKCBOT	0	0	06723	00000 00000 D(B)/DT-B37
.	04763	MKCC	0	0	06724	00000 00000 C-B28
.	04764	MKCCOT	0	0	06725	00000 00000 DC/DT-B37
.	04765	MKSINDP	0	0	06726	00000 00000 SIN(DP) B28
.	04766	MKCSOP	0	0	06727	00000 00000 COS(DP) B28
.	04767	MKSINLHAP	0	0	06730	00000 00000 SIN(LHA-) B28
.	04770	MKLHAP	0	0	06731	00000 00000 LHA- B27 RAD
.	04771	MKAB	0	0	06732	00000 00000 B28-AB=(RT)COS DP
.	04772	MKAB2	0	0	06733	00000 00000 (AB)(AB)-B28
.	04773	MKABOT	0	0	06734	00000 00000 D(AB)/DT B37
.	04774	MKCAIDT	0	0	06735	00000 00000 B37
.	04775	MKCB1	0	0	06736	00000 00000 B28

COMMENT INPUT PARAMETERS FOR INTERCOM

06737	00000	00000	
06740	00000	00000	B28
06741	00000	00000	B37
06742	00000	00000	B27
06743	00000	00000	B28
06744	00000	00000	B28
06745	00000	00000	B27
06746	00000	00000	B28
06747	00000	00000	B28
06750	00000	00000	B27 RAD
06751	00000	00000	B28
06752	00000	00000	B28
06753	00000	00000	RAD/SEC B37
06754	00000	00000	ROD/SEC B37
06755	00000	00000	B37 RAD/SEC
06756	00000	00000	B37
06757	00000	00000	B37
06760	00000	00000	B27
06761	00000	00000	
06762	00000	00000	
06763	00000	00000	B28
06764	00000	00000	DELALF-B28
06765	00000	00000	S=B/R0 (B28)
06766	00000	00000	D0P1-B14
06767	00000	00000	D0P2-B14
06770	00000	00000	D0PPLER-B14
06771	00000	00000	B27
06772	00000	00000	B27
06773	00000	00000	B24
06774	00000	00000	B28
06775	00000	00000	(S) (S) B28
06776	00000	00000	
06777	00000	00000	
07000	00000	00000	B28
07001	00000	00000	B28
07002	00000	00000	TEMP
07003	00000	00000	
07004	00000	00000	
07005	00000	00000	
07006	00000	00000	
07007	00000	00000	
07010	00000	00000	
07011	00000	00000	
07012	00000	00000	
07013	00000	00000	
07014	00000	00000	
07015	00000	00000	
07016	00000	00000	
07017	00000	00000	
07020	00000	00000	
07021	00000	00000	
07022	00000	00000	

. 05070 MKMES02	FD 0*A	07023 06000 00000	
. 05071	-0 \$+1	07024 77777 07025	
. 05072	FD 0*LAT=	07025 21063 14400	
. 05073	77777 77777	07026 77777 77777	
. 05074 MKMESI2	FD 0*X20	07027 35622 40000	
. 05075	10 MKINBETA	07030 00010 06662	
. 05076	7227777777	07031 72277 77777	-90.0B20 LIMITS OF BETA(DFG)
. 05077	0550000000	07032 05500 00000	90.0B20
. 05100 MKMES03	FD 0*A	07033 06000 00000	
. 05101	-0 \$+1	07034 77777 07035	
. 05102	FD 0*LONG=	07035 21242 31444	
. 05103	77777 77777	07036 77777 77777	
. 05104 MKMESI3	FD 0*X20	07037 35622 40000	
. 05105	10 MKINLAMBDA	07040 00010 06663	
. 05106	6457777777	07041 64577 77777	-180.0B20 LIMITS OF LAMBDA(DEG)
. 05107	1320000000	07042 13200 00000	180.0B20
. 05110 MKMES04	FD 0*A	07043 06000 00000	
. 05111	-0 \$+1	07044 77777 07045	
. 05112	FD 0*X(S)=	07045 35513 04044	
. 05113	77777 77777	07046 77777 77777	
. 05114 MKMESI4	FD 0*X28	07047 35627 00000	
. 05115	10 MKXS	07050 00010 06547	
. 05116	5777777777	07051 57777 77777	-1.0B28 LIMITS OF X(S)
. 05117	2000000000	07052 20000 00000	1.0B28
. 05120 MKMES05	FD 0*A	07053 06000 00000	
. 05121	-0 \$+1	07054 77777 07055	
. 05122	FD 0*Y(S)=	07055 36513 04044	
. 05123	77777 77777	07056 77777 77777	
. 05124 MKMESI5	FD 0*X28	07057 35627 00000	
. 05125	10 MKYS	07060 00010 06550	
. 05126 YSLIMIT	5777777777	07061 57777 77777	-1.0B28 LIMITS OF Y(S)
. 05127	2000000000	07062 20000 00000	1.0B28
. 05130 MKMES00	FD 0*A	07063 06000 00000	
. 05131	-0 \$+1	07064 77777 07065	
. 05132	FD 0*OFFSET (Y/N)	07065 24131 33012	
. 05133	77777 77777	07066 31055 13674	
. 05134 MKMESI0	FD 0*Y	07067 23400 00000	
. 05135	0 MOONSW\$	07070 77777 77777	
. 05136 MKMES01	FD 0*A	07071 36000 00000	
. 05137	-0 \$+1	07072 00000 63343	
. 05140	FD 0*LAT+LONG(1) DIR. COS(2) OBSERVER	07073 06000 00000	
	CO	07074 77777 07075	
		07075 21063 14221	
		07076 24231 45161	
		07077 40051 11627	
		07100 75051 02430	
		07101 51624 00524	
		07102 07301 22733	
		07103 12270 51024	
		07104 24271 15163	
		07105 40051 11221	
		07106 06364 20623	
		07107 14516 44000	
		07110 77777 77777	
		07111 24000 00000	
		07112 00010 07115	
		07113 00000 00001	1
. 05141	FD 0*ORD(3) DELAY+ANG(4)		
. 05142	77777 77777		
. 05143 MKMESI1	FD 0*0		
. 05144	10 MKSWITCH		
. 05145	0000000001		

• 05146	0000000004	07114	00000	00004	4
• 05147 MKSWITCH	1	07115	00000	00001	
• 05150 MKMES06	FD 0*A	07116	06000	00000	
• 05151	-0 \$+1	07117	77777	07120	
• 05152	FD 0*X(0)=	07120	35512	44044	
• 05153	77777 77777	07121	77777	77777	
• 05154 MKMES16	FD 0*X28	07122	35627	00000	
• 05155	10 MKX0	07123	00010	06544	
• 05156	5777777777	07124	57777	77777	-1.0R28 LIMITS OF X(0)
• 05157	2000000000	07125	20000	00000	1.0B28
• 05160 MKMES07	FD 0*A	07126	06000	00000	
• 05161	-0 \$+1	07127	77777	07130	
• 05162	FD 0*Y(0)=	07130	36512	44044	
• 05163	77777 77777	07131	77777	77777	
• 05164 MKMES17	FD 0*X28	07132	35627	00000	
• 05165	10 MKY0	07133	00010	06545	
• 05166 YOLIMIT	5777777777	07134	57777	77777	-1.0B28 LIMITS OF Y(0)
• 05167	2000000000	07135	20000	00000	1.0B28
• 05170 MKMES08	FD 0*A	07136	06000	00000	
• 05171	-0 \$+1	07137	77777	07140	
• 05172	FD 0*DELAY(MS)=	07140	11122	10636	
		07141	51223	04044	
		07142	77777	77777	
• 05173	77777 77777	07143	35626	50000	
• 05174 MKMES18	FD 0*X25	07144	00010	06660	
• 05175	10 MKIDELAY	07145	00000	00000	0.0B25 LIMITS OF DELAY(MS)
• 05176	0000000000	07146	30000	00000	12.0B25
• 05177	3000000000	07147	06000	00000	
• 05200 MKMES09	FD 0*A	07150	77777	07151	
• 05201	-0 \$+1	07151	06231	42112	
• 05202	FD 0*ANGLE=	07152	44000	00000	
		07153	77777	77777	
• 05203	77777 77777	07154	35622	40000	
• 05204 MKMES19	FD 0*X20	07155	00010	06661	
• 05205	10 MKIANG	07156	51377	77777	-360.0B20 LIMITS OF ANGLE(DEG)
• 05206	5137777777				
		07157	26400	00000	360.0B20
• 05207	2640000000	07160	00000	00000	
• 05210 EPHP	0 0	07161	00000	00000	FOR EPHRST INTERP ONLY
• 05211 MOD2PI	0				
• 05212	COMMENT FOLLOWING VALUES AT B26,B42,B2				
	6,B26				
• 05213 MKQK1	0 0	07162	00000	00000	
• 05214 MKQRSOT	0 0	07163	00000	00000	X D/DT(R-S)
• 05215 MKQI	0 0	07164	00000	00000	X
• 05216 MKQSP	0 0	07165	00000	00000	X
• 05217 MKQISIN	0 0	07166	00000	00000	SIN I B28
• 05220 MKQICUS	0 0	07167	00000	00000	COS I B28
• 05221	COMMENT EPHCNT = NO. OF VALUES IN EACH				
	OF THE 4 TABLES				
• 05222	COMMENT EPHDAY = DAY OF VALIDITY OF FI				
	RST ENTRY IN EACH OF 4 TBLS				
• 05223 EPHDAY	-1	07170	77777	77776	
• 05224	COMMENT				
• 05225	COMMENT EPHEMERIS INPUT				
• 05226	COMMENT THE STORAGE AND TABLES MUST BE				
	IN THE ORDER RST,RSTDT,I,SP				
• 05227	COMMENT				
• 05230	COMMENT FOLLOWING VALUES FOR YEAR 1969				

•	U5231	EPHCNT	EQUALS	38D			
•	U5232		COMMENT	FOLLOWING VALUES FOR YEAR 1969			
•	U5233	EPHRST	1742203655	07171	17422	03655	3.88381835826
•	U5234		3056646750	07172	30566	46750	6.18291439826
•	U5235		1062716356	07173	10627	16356	2.19884084826
•	U5236		2177364062	07174	21773	64062	4.49795608826
•	U5237		0203431432	07175	02034	31432	0.51386682826
•	U5240		1320076564	07176	13200	76564	2.81297857826
•	U5241		2434542044	07177	24345	42044	5.11207635826
•	U5242		0440607227	07200	04406	07227	1.12798535826
•	U5243		1555254733	07201	15552	54733	3.42710059826
•	U5244		2671720026	07202	26717	20026	5.72619663826
•	U5245		0675765211	07203	06757	65211	1.74210563826
•	U5246		2012432715	07204	20124	32715	4.04122087826
•	U5247		0016500265	07205	00165	00265	0.05713161826
•	U5250		1133143360	07206	11331	43360	2.35622765826
•	U5251		2247610677	07207	22476	10677	4.65534114826
•	U5252		0253656247	07210	02536	56247	0.67125188826
•	U5253		1370323566	07211	13703	23566	2.97036538826
•	U5254		2504771104	07212	25047	71104	5.26947887826
•	U5255		0511036454	07213	05110	36454	1.28538961826
•	U5256		1625503773	07214	16255	03773	3.58450311826
•	U5257		2742151312	07215	27421	51312	5.88361660826
•	U5260		0746221272	07216	07462	21272	1.89954654826
•	U5261		2062664201	07217	20626	64201	4.19864084826
•	U5262		0066733773	07220	00667	33773	0.21456903826
•	U5263		1203401477	07221	12034	01477	2.51368427826
•	U5264		2320046631	07222	23200	46631	4.81279602826
•	U5265		0324114366	07223	03241	14366	0.82870851826
•	U5266		1440561520	07224	14405	61520	3.12782026826
•	U5267		2555227036	07225	25552	27036	5.42693375826
•	U5270		0561277017	07226	05612	77017	1.44286369826
•	U5271		1675744150	07227	16757	44150	3.74197544826
•	U5272		3012413713	07230	30124	13713	6.04110639826
•	U5273		1016463673	07231	10164	63673	2.05703633826
•	U5274		2133133250	07232	21331	33250	4.35616553826
•	U5275		0137203230	07233	01372	03230	0.37209547826
•	U5276		1253652772	07234	12536	52772	2.67122642826
•	U5277		2370322347	07235	23703	22347	4.97035562826
•	U5300		0374374552	07236	03743	74552	0.98630301826
•	U5301	EPHRSTOT	0054511643	07237	00545	11643	.04359783828
•	U5302		0054511643	07240	00545	11643	.04359783828
•	U5303		0054511746	07241	00545	11746	.04359808828
•	U5304		0054511643	07242	00545	11643	.04359783828
•	U5305		0054511653	07243	00545	11653	.04359786828
•	U5306		0054511663	07244	00545	11663	.04359789828
•	U5307		0054511560	07245	00545	11560	.04359764828
•	U5310		0054511663	07246	00545	11663	.04359789828
•	U5311		0054511663	07247	00545	11663	.04359789828
•	U5312		0054511560	07250	00545	11560	.04359764828
•	U5313		0054511663	07251	00545	11663	.04359789828
•	U5314		0054511663	07252	00545	11663	.04359789828
•	U5315		0054511560	07253	00545	11560	.04359764828
•	U5316		0054511663	07254	00545	11663	.04359789828
•	U5317		0054511653	07255	00545	11653	.04359786828
•	U5320		0054511643	07256	00545	11643	.04359783828
•	U5321		0054511746	07257	00545	11746	.04359808828
•	U5322		0054511643	07260	00545	11643	.04359783828

• 05323	0054511643	07261	00545 11643	•04359783828
• 05324	0054511736	07262	00545 11736	•04359805828
• 05325	0054511736	07263	00545 11736	•04359805828
• 05326	0054511643	07264	00545 11643	•04359783828
• 05327	0054511643	07265	00545 11643	•04359783828
• 05330	0054511736	07266	00545 11736	•04359805828
• 05331	0054511736	07267	00545 11736	•04359805828
• 05332	0054511643	07270	00545 11643	•04359783828
• 05333	0054511643	07271	00545 11643	•04359783828
• 05334	0054511736	07272	00545 11736	•04359805828
• 05335	0054511726	07273	00545 11726	•04359802828
• 05336	0054511721	07274	00545 11721	•04359800828
• 05337	0054512014	07275	00545 12014	•04359822828
• 05340	0054512004	07276	00545 12004	•04359819828
• 05341	0054512004	07277	00545 12004	•04359819828
• 05342	0054512004	07300	00545 12004	•04359819828
• 05343	0054511773	07301	00545 11773	•04359816828
• 05344	0054512067	07302	00545 12067	•04359838828
• 05345	0054512056	07303	00545 12056	•04359835828
• 05346	0054512056	07304	00545 12056	•04359835828
• 05347 EPHI	0141727677	07305	01417 27677	•38250636826
• 05350	0141725454	07306	01417 25454	•38248891826
• 05351	0141723230	07307	01417 23230	•38247145826
• 05352	0141721005	07310	01417 21005	•38245400826
• 05353	0141721005	07311	01417 21005	•38245400826
• 05354	0141716562	07312	01417 16562	•38243655826
• 05355	0141716562	07313	01417 16562	•38243655826
• 05356	0141714336	07314	01417 14336	•38241909826
• 05357	0141714336	07315	01417 14336	•38241909826
• 05360	0141714336	07316	01417 14336	•38241909826
• 05361	0141714336	07317	01417 14336	•38241909826
• 05362	0141714336	07320	01417 14336	•38241909826
• 05363	0141716562	07321	01417 16562	•38243655826
• 05364	0141716562	07322	01417 16562	•38243655826
• 05365	0141721005	07323	01417 21005	•38245400826
• 05366	0141721005	07324	01417 21005	•38245400826
• 05367	0141723230	07325	01417 23230	•38247145826
• 05370	0141725454	07326	01417 25454	•38248891826
• 05371	0141727677	07327	01417 27677	•38250636826
• 05372	0141734346	07330	01417 34346	•38254127826
• 05373	0141736571	07331	01417 36571	•38255872826
• 05374	0141743237	07332	01417 43237	•38259362826
• 05375	0141747705	07333	01417 47705	•38262853826
• 05376	0141754354	07334	01417 54354	•38266344826
• 05377	0141761022	07335	01417 61022	•38269834826
• 05400	0141765471	07336	01417 65471	•38273325826
• 05401	0141772140	07337	01417 72140	•38276816826
• 05402	0142001032	07340	01420 01032	•38282052826
• 05403	0142005500	07341	01420 05500	•38285542826
• 05404	0142014372	07342	01420 14372	•38290778826
• 05405	0142023263	07343	01420 23263	•38296014826
• 05406	0142032155	07344	01420 32155	•38301250826
• 05407	0142041047	07345	01420 41047	•38306486826
• 05410	0142047741	07346	01420 47741	•38311722826
• 05411	0142056633	07347	01420 56633	•38316958826
• 05412	0142067750	07350	01420 67750	•38323940826
• 05413	0142076642	07351	01420 76642	•38329176826
• 05414	0142107757	07352	01421 07757	•38336157826
• 05415 EPHSP	7776372616	07353	77763 72616	-0.00589921826

•	05416	7776521552
•	05417	7776646263
•	05420	7776775220
•	05421	7777124154
•	05422	7777253110
•	05423	7777402044
•	05424	7777531001
•	05425	7777657735
•	05426	0000006671
•	05427	0000135625
•	05430	0000264562
•	05431	0000413516
•	05432	0000542452
•	05433	0000671407
•	05434	0001020343
•	05435	0001147300
•	05436	0001276234
•	05437	0001425170
•	05440	0001554124
•	05441	0001703061
•	05442	0002027572
•	05443	0002156526
•	05444	0002305462
•	05445	0002432173
•	05446	0002561130
•	05447	0002705641
•	05450	0003034574
•	05451	0003161305
•	05452	0003306017
•	05453	0003432530
•	05454	0003561464
•	05455	0003706175
•	05456	0004032706
•	05457	0004155173
•	05460	0004301705
•	05461	0004426416
•	05462	0004550704

07354	77765	21552	-0.00523599826
07355	77766	46263	-0.00459022826
07356	77767	75220	-0.00392699826
07357	77771	24154	-0.00326377826
07360	77772	53110	-0.00260054826
07361	77774	02044	-0.00193732826
07362	77775	31001	-0.00127409826
07363	77776	57735	-0.00061087826
07364	00000	06671	00.00005236826
07365	00001	35625	00.00071558826
07366	00002	64562	00.00137881826
07367	00004	13516	00.00204204826
07370	00005	42452	00.00270526826
07371	00006	71407	00.00336849826
07372	00010	20343	00.00403171826
07373	00011	47300	00.00469494826
07374	00012	76234	00.00535816826
07375	00014	25170	00.00602139826
07376	00015	54124	00.00668461826
07377	00017	03061	00.00734784826
07400	00020	27572	00.00799361826
07401	00021	56526	00.00865683826
07402	00023	05462	00.00932006826
07403	00024	32173	00.00996583826
07404	00025	61130	00.01062906826
07405	00027	05641	00.01127483826
07406	00030	34574	00.01193805826
07407	00031	61305	00.01258382826
07410	00033	06017	00.01322960826
07411	00034	32530	00.01387537826
07412	00035	61464	00.01453859826
07413	00037	06175	00.01518436826
07414	00040	32706	00.01583014826
07415	00041	55173	00.01645845826
07416	00043	01705	00.01710423826
07417	00044	26416	00.01775000826
07420	00045	50704	00.01837832826
07421	00112	30264	
07422	00112	32001	
07423	31050	00005	
07424	60606	06060	

SPURT OUTPUT NO. 111

MOONTRACK		P.CROWTHER*20FEB69			
LABEL	LOC	LABEL	LOC	LABEL	LOC
A\$\$\$\$\$1111	07421	A\$\$\$\$\$1112	07422	A\$\$\$\$\$1113	07423
A\$\$\$\$\$1114	07424	ACQAZIM	63071	ACQELEV	63075
ACQUI	63427	ACTUALTIME	63142	ADSCN	63416
AEBUXLINES	63507	AEPHEM	01453	AESCN	63417
AIRPORT	00237	ALNGOFFSET	63517	ALNGARCSN	63506
ARCOFAZIM	63524	ARCOFDEC	63526	ARCOFELEV	63522
ARCOFRA	63530	AREACNT	02215	ASIN	06505
ASINX	06505	ASTRODEC	63106	ASTRORA	63105
ATAN	06154	AUPEREQUAT	63341	AUTOSWITCH	63025
AUTOT	63437	AZDIFS	63120	AZELOTIME	63532
AZELBXSCAN	63500	AZELIND\$	63162	AZIM	63053
AZIMOFFSET	63512	AZIMOUT	64000	AZIMOVER	63325
AZIMADD	63442	AZIMERROR\$	63027	AZIMIN	75000
AZMTHSCAN	63501	AZTRACKERR	63022	BODYSIZE	63462
BOTHNEG1	01352	BOTHNEG2	01374	BOTHNEG3	01416
BESSEL	01115	BETA	01103	BLASTOFF	63146
BUST	00602	COCON	63414	CONVERTIME	63135
CORCT	63420	COS	06343	COSORIENT	63065
COSAZEL	63070	COSX	06343	CAZIM	63060
CELBODY	63113	CELCOMP\$	63424	CELEV	63061
CELMOON	00002	CELTIME	63133	CERO	00471
CHCOR	63422	CHPAR	63431	CIVIL	01233
CRANGE	63057	CRSSOFFSET	63516	DOPFACTOR\$	63167
JOPFREQ\$	63166	DOPPOUT	66000	DOPPAD	63444
DOPPL	63164	DOPPLER\$	63165	DOPSWITCH\$	63163
DATANALYZE	63425	DAY	63150	DAYFIND	00437
JAYINCRMNT	00503	DAYREG\$	63172	DEC	63003
DECOFFSET	63515	DECAD	01445	DECDOT	63010
DECUIFAD	01446	DECLINRAD	00272	DECLINSCAN	63505
DELTA	01105	DELTATEE	63316	DISTAD	01447
DISTDIFAD	01450	DLN	00721	DLN1	00737
DLN2	00743	DLN3	00744	DLN4	00746
DLN5	00747	DLN6	00751	DLN7	00752
DMIN2CPLB	01113	DMINB	01112	DRIFTAZIM\$	63534
DRIFTELEV\$	63535	DRIFTSCAN\$	63533	DSECONDS	63141
DSIDERT	04217	DUMSECTG	63154	DYDMP	63421
ELDIFS	63121	ELEV	63054	ELEVOFFSET	63513
ELEVOUT	65000	ELEVADD	63443	ELEVERROR\$	63030
ELEVIN	76000	ELTRACKERR	63023	ELVTNSCAN	63502
EP2BM2DMA	01114	EPHCNT	00046	EPHDAY	07170
EPHEMA	03653	EPHEMB	03654	EPHEMC	03655
EPHEMD	03656	EPHEME	03657	EPHEMF	03660
EPHEMTAPE	00002	EPHI	07305	EPHINTERP	00367
EPHP	07160	EPHRST	07171	EPHRSTDT	07237
EPHSP	07353	EPSILON	01106	EQUATOR	63323
ERNMSEC	01065	ESTSHIFTED	63143	EXPNAME	63350
FBESSEL	01130	FIRSTDIFF	01102	FIRSTELEV	63104
FIRSTTHRU	63153	FIX1	01272	FIX2	01300
FIX3	01306	FLOTEST1	01340	FLOTEST2	01362
FLOTEST3	01404	FLATNEG	00442	FLATPOS	00456
FLATTENING	63337	FRAMESIZE	63101	FREQUENCY	63317
FUNCTION	01107	GAMMA	01104	GEOCNLAT	63322

GEODETLAT 63321
 GMT2 00776
 GMT5 01002
 GMTMODU24 63145
 HOUR 01054
 HALF 01111
 HDAY 01060
 HRAU 01056
 ID12RADIO 67777
 ID15RADIO 71776
 ID18RADIO 72777
 ID1ENTPNT 63410
 ID1RECRD 63210
 ID1SYSPAR 63310
 ID21RADIO 74776
 ID24RADIO 75777
 ID2CELCOR 63001
 ID2RADIO 63441
 ID2SYSNAM 77677
 ID3RADIO 63776
 ID6RADIO 64777
 ID9RADIO 66776
 INAZIMADD 63446
 INITIAL12 00665
 INITIAL2 00652
 INITIALBOD 01020
 INITIALJD 00644
 INTERCUM 63426
 INTERPOL 01136
 INTRELCKSW 63460
 KEY 01101
 KYBRDSPEC1 63344
 KYBRDSPEC4 63347
 LESSONE 00460
 LSPERAU 63336
 MOONINIT 00005
 MOONUTAG 00000
 MODESWITCH 63024
 MOREONE 00462
 MCPGM 63412
 MINKEG 63152
 MKOFFSW 06657
 MK10 06577
 MK13 06602
 MK16 06605
 MK19 06610
 MK3 06570
 MK5 06572
 MK8 06575
 MKAB2 06733
 MKAPDT 06560
 MKBP 06742
 MKCOSBP 06744
 MKCOSDA 06761
 MKCOSDPHI 06716
 MKCOSLHA 06707
 MKCOSZO 06712
 MKCA1DT 06735
 MKCB1 06736

GMT 00754
 GMT3 00777
 GMT6 01004
 GMTSHIFTED 63144
 HOURMINUTE 63137
 HALFDAY 01046
 HEIGHT 63326
 ID10RADIO 66777
 ID13RADIO 70775
 ID16RADIO 71777
 ID19RADIO 73776
 ID1RADCOR 63050
 ID1SYSENT 77576
 ID1TIME 63130
 ID22RADIO 74777
 ID25RADIO 76775
 ID2ENPNT 63411
 ID2RECRD 63211
 ID2SYSFAR 63311
 ID4RADIO 63777
 ID7RADIO 65776
 IGNORE 01051
 INELEVAOD 63447
 INITIAL17 01015
 INITIAL20 01026
 INITIALDAT 00655
 INTER 63413
 INTERDOPP 74000
 INTERRANGE 76777
 JULIANDAY 01440
 KMPERNM 63342
 KYBRDSPEC2 63345
 LONGITUDE 63320
 LINCOLN 01235
 LUNAR 00100
 MOONSW\$ 63343
 MOONWORK 00243
 MONITAPE 00055
 MAINSWITCH 63334
 MDAY 01061
 MINSRAD 01057
 MKONE28 06627
 MK11 06600
 MK14 06603
 MK17 06606
 MK2 06567
 MK4 06571
 MK6 06573
 MK9 06576
 MKABDT 06734
 MKB1STOR 00435
 MKBPDT 06753
 MKCOSCP 06752
 MKCOSDEC 06651
 MKCOSGLAT 06653
 MKCOSLP 06747
 MKCA 06720
 MKCADT 06721
 MKCB1DT 06737

GMT1 00772
 GMT4 01001
 GMT7 01005
 HOLDNOHOLD 63511
 HOURREG 63151
 HARVARD 00246
 HIRESDOP\$ 63171
 ID11PADIO 67776
 ID14RADIO 70776
 ID17RADIO 72776
 ID1CELCOR 63000
 ID1RADIO 63440
 ID1SYSNAM 77676
 ID20RADIO 73777
 ID23RADIO 75776
 ID26RADIO 76776
 ID2RADCOR 63051
 ID2SYSENT 77577
 ID2TIME 63131
 ID5RADIO 64776
 ID8RADIO 65777
 IMPERIAL 01441
 INITIAL11 00663
 INITIAL18 01017
 INITIAL3 00654
 INITIALDIS 01007
 INTERAZIM 72000
 INTERELEV 73000
 INTERRUPT 01052
 KENNEDY 01126
 KYBRDLEVEL 63110
 KYBRDSPEC3 63346
 LASTEPHEM 03652
 LINECOUNT\$ 63127
 MOONDOP2\$ 63170
 MOONTIME 00504
 MOD2PI 07161
 MONTHPRINT 01032
 MCPFILLER 71000
 MILLSTNADD 63451
 MINUS 01327
 MK1 06566
 MK12 06601
 MK15 06604
 MK18 06607
 MK20 06611
 MK42 06777
 MK7 06574
 MKAB 06732
 MKALFP 06561
 MKBETA 06664
 MKCOSB 06667
 MKCOSDA 06702
 MKCOSDP 06727
 MKCOSL 06671
 MKCOSPHID 06711
 MKCA1 06760
 MKCB 06722
 MKCBDT 06723

MKCC	06724	MKCC1	06740	MKCC1DT	06741
MKCCDT	06725	MKCP	06750	MKD0	06645
MKD02	06646	MKD0P1	06766	MKD0P2	06767
MKD0PP	06564	MKD0PPLER	06770	MKDANG	06700
MKD0T	06654	MKD0TX	06655	MKDDTC05Z	06717
MKD0TR	06774	MKDEC	06644	MKDECD0T	06642
MKDELALF	06764	MKDELAY	06555	MKDELAYCNT	07022
MKDELDEL	06763	MKDKK2	06705	MKDP	06563
MKDPDT	06562	MKDPX	06773	MKFCL	06557
MKGEO LAT	06647	MKHLF	06621	MKIANG	06661
MKIDELAY	06660	MKINBETA	06662	MKINLAMBD A	06663
MKLOK	05357	MKLAG	05356	MKLAMBD A	06665
MKLCON	05350	MKLHA	06552	MKLHADT	06553
MKLHAP	06731	MKLP	06745	MKL PDT	06754
MKMES00	07063	MKMES01	07073	MKMES02	07023
MKMES03	07033	MKMES04	07043	MKMES05	07053
MKMES06	07116	MKMES07	07126	MKMES08	07136
MKMES09	07147	MKMESI0	07071	MKMESI1	07111
MKMESI2	07027	MKMESI3	07037	MKMESI4	07047
MKMESI5	07057	MKMESI6	07122	MKMESI7	07132
MKMESI8	07143	MKMESI9	07154	MKPOSSW	06656
MKQ11	06617	MKQ180	06637	MKQ90	06635
MKQALF	06630	MKQBER	06634	MKQBNM	06633
MKQCCER	06615	MKQERPNI	06631	MKQFC	06632
MKQI	07164	MKQIC05	07167	MKQISIN	07166
MKQK1	07162	MKQNM PER	06616	MKQRO	06623
MKQR11	06620	MKQRCNM	06640	MKQRH0	06624
MKQRH0X	06625	MKQRS0T	07163	MKQSP	07165
MKQWE	06626	MKRO	06554	MKR0DT	06556
MKRA	06643	MKRAD0T	06641	MKRADDEG	06636
MKRH0DC05	06713	MKRK1	06612	MKRK2	06613
MKRK3	06614	MKRT	06565	MKRT2	06714
MKRTX	06772	MKRTX2	06771	MKS	06765
MKS2	06775	MKSINB	06666	MKSINRP	06743
MKSINCP	06751	MKSINDA	06701	MKSINDDA	06762
MKSINDEC	06650	MKSINDP	06726	MKSINDPHI	06715
MKSINGLAT	06652	MKSINL	06670	MKSINLHA	06706
MKSINLHAP	06730	MKSINLP	06746	MKSINPHID	06710
MKSWITCH	07115	MKT1	07000	MKT10	07007
MKT11	07010	MKT12	07011	MKT13	07014
MKT14	07015	MKT15	07016	MKT16	07017
MKT17	07020	MKT18	07021	MKT2	07001
MKT3	07002	MKT4	07003	MKT5	07012
MKT6	07013	MKT7	07004	MKT8	07005
MKT9	07006	MKWA	06757	MKWX	06755
MKXY	06756	MKX0	06544	MKX02	06675
MKXJ	06776	MKXS	06547	MKXS2	06672
MKY0	06545	MKY02	06676	MKYS	06550
MKYS2	06673	MKZ0	06546	MKZ02	06677
MKZR0	06704	MKZR02	06703	MKZS	06551
MKZS2	06674	MSFREQ	63332	MXA	04517
MXA1	05055	MXALF	04677	MXAPDT	05017
MXB	04553	MXB1	05146	MXBPD T	05413
MXC	04625	MXC1	05230	MXDOP	04472
MXDA	05543	MXDECPDT	04740	MXDELALF	05674
MXDELP	04661	MXDPDOP	05761	MXFCL	05466
MXINIT	03662	MXINPOSA	03705	MXINPOSB	03761
MXINPOSC	04026	MXINPOSD	04073	MXINTAB	03701
MXLHA	04202	MXLPDT	05424	MXR0	04220

MXROBACK	04342
MXSINBP	05312
MXXYZ	05563
NOFL01	01271
NORMAL	00112
NUMFILES	00014
PERIODAZIM	63523
PERIODRA	63527
PLOTP	63436
PREVIOUSM	63461
PRLOG	63423
ROUND	01426
RA1	00704
RA4	00713
RA7	00717
RADARMODE	63312
RADIODEC	63541
RADIFAD	01444
RADIUSDOT	63011
RANGEADD	63445
RD0T0IFS	63123
RDMTR	63430
RECAZIM	67000
RECRD	63415
REFRACCOR\$	63031
REMAINDER	01227
RGHTASC	00666
SOVMSG	06277
SADU1	06314
SAFE	01452
SCELTIME	63134
SECONDS	63140
SETINTAD	01135
SINORIENT	63064
SIXTH	01125
SLAVEUPTS	63124
SRA	63004
SRHIBIN	01050
SSUB1	06332
STOR2	01223
STORE	00472
SYNCAINBCW	63543
SYNCELBCW\$	63546
SYSCOMREG2	63453
SYSCOMREG5	63456
SYSNAMES	77700
SYSTATD	63315
TAPEBUST1	00617
TAPSTAT	00624
THIRD	01124
TIMEMODE	63103
TRACKINDIC	63026
TRYAGAIN	00044
TWOPIE	01067
VIZDEC1	63014
VIZRA2	63015
WFFREQ	63333
YEARMONTH	63147
YRTRAN	63327

MXRODT	04351
MXSINCP	05375
NODATA	00627
NOFL02	01277
NMPERAU	63340
P	01110
PERIODDEC	63525
PLOTAZIM\$\$	63020
PLANP	63434
PRINRECSW	63160
PSOMP	01122
RA	63002
RA2	00710
RA5	00714
RAAD	01443
RADCBXSCAN	63503
RADIOMETER	63102
RADINDIC	63157
RANGE	63052
RANGEDOT	63062
RDBOXLINES	63510
RDXXX	63433
RECELEV	70000
RECRDSWTH	63155
REFRACIND\$	63161
REVS RADIAN	01047
RHRSEC	01066
SOVSTR	06304
SADD2	06320
SARAD	01064
SDAY	01062
SECSRAD	01063
SIDERTIME	63012
SINAZEL	63066
SKIP	63331
SLAVEMODES	63125
SRAD	01055
SSBXT	06337
SSUB2	06336
STOR3	01251
STATUSCK	00533
SYNCAZBCW\$	63545
SYNCTIMING	63542
SYSCOMREG3	63454
SYSCOMREG6	63457
SYSTAT1	63313
TAPEBLOCK	01442
TAPEINPUT	00035
TEMP	06342
TIME2	01451
TIMEP	63435
TRUERANGE	63063
TTYSTATUS	63111
TWOSECDOP	63017
VIZDEC2	63016
WFORD	63432
WHOLEYEAR	01437
YEARPRINT	01070
YSLIMIT	07061

MXRODTBACK	04470
MXSINLP	05327
NODATA2	00635
NOFL03	01305
NUMDEFIV	01127
POLE	63324
PERIODELEV	63521
PL0TELEV\$	63021
PLUS	01333
PRINT	00221
PSOMP6	01123
RAOFFSET	63514
RA3	00711
RA6	00716
RADOT	63007
RADECOTIME	63531
RADIOPA	63540
RADIUS	63006
RANGEOUT	70777
RASCTNSCAN	63504
RDIFS	63122
RECORDSIZE	63112
RECFILE	63212
RECSIZE	00010
RELEASESW	63156
REWINDNO	01053
SOVERFLOW	06257
SADD	06305
SADXT	06321
SAZIM	63055
SDC	63005
SELEV	63056
SIN	06354
SINX	06354
SLAVE	63126
SORT	06441
SRADTIME	63136
SSIR	06324
STOR1	01205
STOR4	01265
SUM	01336
SYNCEINBCW	63544
SYSCOMREG1	63452
SYSCOMREG4	63455
SYSENTRIES	77600
SYSTAT2	63314
TAPERUST	00615
TAPESEARCH	03661
TENB25	06622
TIMECORR	63107
TIMETOHOLD	63520
TRUE TIME	63132
TWOLESS	00454
VELOFLIGHT	63335
VIZRA1	63013
WFADD	63450
YOLIMIT	07134
YRREMAIN	01436
ZRTRAN	63330

SPURT OUTPUT NO. 112

MOONTRACK

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LABEL	LOC	LABEL	LOC	LABEL	LOC
MOONUTAG	00000	EPHEMTAPE	00002	CELMOON	00002
MOONINIT	00005	RECSIZE	00010	NUMFILES	00014
TAPEINPUT	00035	TRYAGAIN	00044	EPHCNT	00046
MONITAPE	00055	LUNAR	00100	NORMAL	00112
PRINT	00221	AIRPORT	00237	MOONWORK	00243
HARVARD	00246	DECLINRAD	00272	EPHINTERP	00367
MKB1STOR	00435	DAYFIND	00437	FLATNEG	00442
TWOLESS	00454	FLATPOS	00456	LESSONE	00460
MOREONE	00462	CERO	00471	STORE	00472
DAYINCRMNT	00503	MOONTIME	00504	STATUSCK	00533
BUST	00602	TAPEBUST	00615	TAPEBUST1	00617
TAPSTAT	00624	NODATA	00627	NODATA2	00635
INITIALJD	00644	INITIAL2	00652	INITIAL3	00654
INITIALDAT	00655	INITIAL11	00663	INITIAL12	00665
RGHTASC	00666	RA1	00704	RA2	00710
RA3	00711	RA4	00713	RA5	00714
RA6	00716	RA7	00717	DLN	00721
DLN1	00737	DLN2	00743	DLN3	00744
DLN4	00746	DLN5	00747	DLN6	00751
DLN7	00752	GMT	00754	GMT1	00772
GMT2	00776	GMT3	00777	GMT4	01001
GMT5	01002	GMT6	01004	GMT7	01005
INITIALDIS	01007	INITIAL17	01015	INITIAL18	01017
INITIALBOD	01020	INITIAL20	01026	MONTHPRINT	01032
HALFDAY	01046	REVSADIAN	01047	SRHIBIN	01050
IGNORE	01051	INTERUPT	01052	REWINDNO	01053
HOUR	01054	SRAD	01055	HRAD	01056
MINSRAD	01057	HDAY	01060	MDAY	01061
SDAY	01062	SECSRAD	01063	SARAD	01064
ERNMSEC	01065	RHRSEC	01066	TWOPIE	01067
YEARPRINT	01070	KEY	01101	FIRSTDIFF	01102
BETA	01103	GAMMA	01104	DELTA	01105
EPSILON	01106	FUNCTION	01107	P	01110
HALF	01111	DMINB	01112	DMIN2CPLB	01113
EP26M2DMA	01114	BESSEL	01115	PSQMP	01122
PSQMP6	01123	THIRD	01124	SIXTH	01125
KENNEDY	01126	NUMDERIV	01127	FBESSEL	01130
SETINTAD	01135	INTERPOL	01136	STOR1	01205
STOR2	01223	REMAINDER	01227	CIVIL	01233
LINCOLN	01235	STOR3	01251	STOR4	01265
NOFL01	01271	FIX1	01272	NOFL02	01277
FIX2	01300	NOFL03	01305	FIX3	01306
MINUS	01327	PLUS	01333	SUM	01336
FLOTEST1	01340	BOTHNEG1	01352	FLOTEST2	01362
BOTHNEG2	01374	FLOTEST3	01404	BOTHNEG3	01416
ROUND	01426	YRREMAIN	01436	WHOLEYEAR	01437
JULIANDAY	01440	IMPERIAL	01441	TAPEBLOCK	01442
RAAD	01443	RADIFAD	01444	DECAD	01445
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